

DETECTING THE MISSING BARYONS IN X-RAY ABSORPTION

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06/04 MARYLAND

MISSING BARYONS, IN THE FORM OF THE WHIM:

<u><i>Absorption</i></u>	<u><i>Imaging</i></u>
Depend on background sources	No dependency on background sources
Sensitive to density	Sensitive to density square
No dependency on the XRB	Removal of the XRB

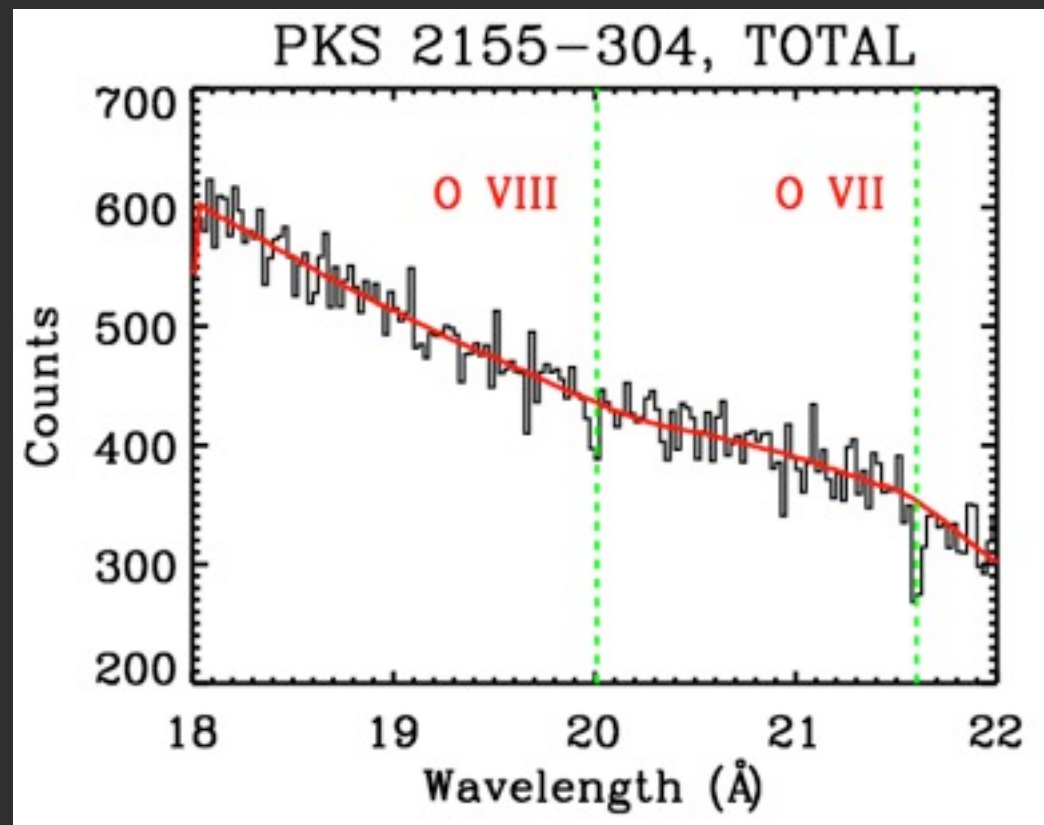
<u><i>Ultraviolet</i></u>	<u><i>X-ray</i></u>
H I, O VI, C IV	O VII, O VIII, C V, Ne X
Plasma with $T \sim 10^5$ - 10^6 K	Plasma with $T > 10^6$ K

S5 0836+710 PKS 2149-306	Fang et al. (2001)	HETG	No detection
PKS 2155-304	Fang et al. (2002)	LETG	> 3-sigma
H 1821-643	Mathur et al. (2003)	LETG	2-sigma
3C 120	McKernan et al. (2003)	HETG	~ 3-sigma
LBQS 1228+1116	Fujimoto et al. (2004)	RGS	~ 2-3 sigma
Mkn 421	Nicastro et al. (2005)	LETG	> 3-sigma
X Comae	Takei et al. (2006)	RGS	2-sigma
PKS 0558-504	Nicastro et al. (2009)	RGS	~ 2-3 sigma

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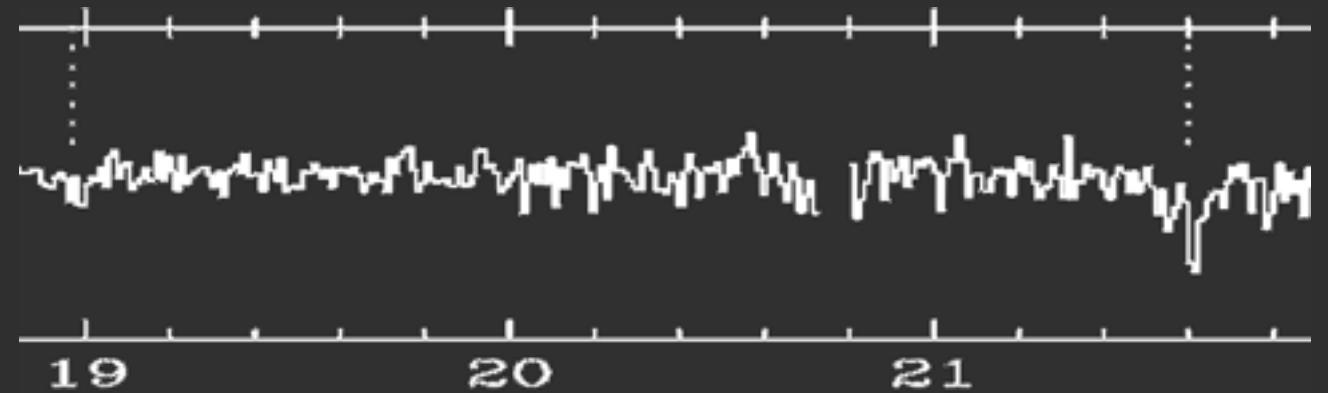
ISSUE 1: INCONSISTENCY BETWEEN INSTRUMENTS

CHANDRA LETG



FANG ET AL. (2007)

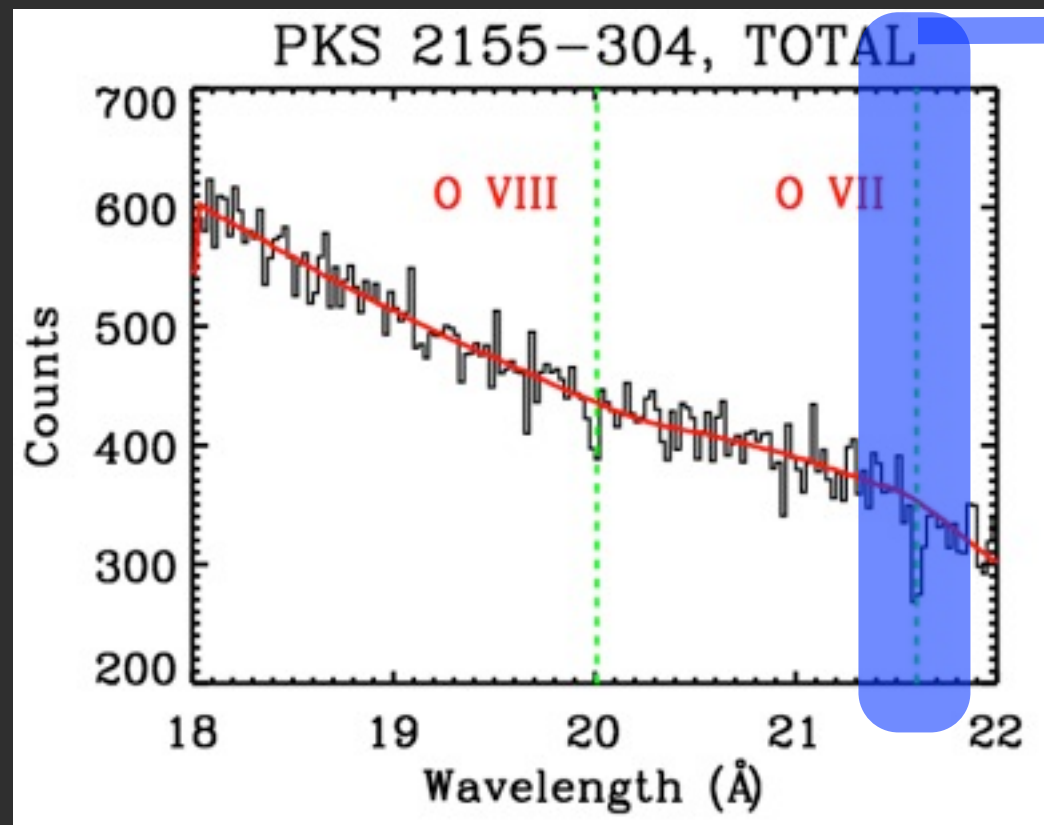
XMM RGS



RASMUSSEN ET AL. (2003)

ISSUE 1: INCONSISTENCY BETWEEN INSTRUMENTS

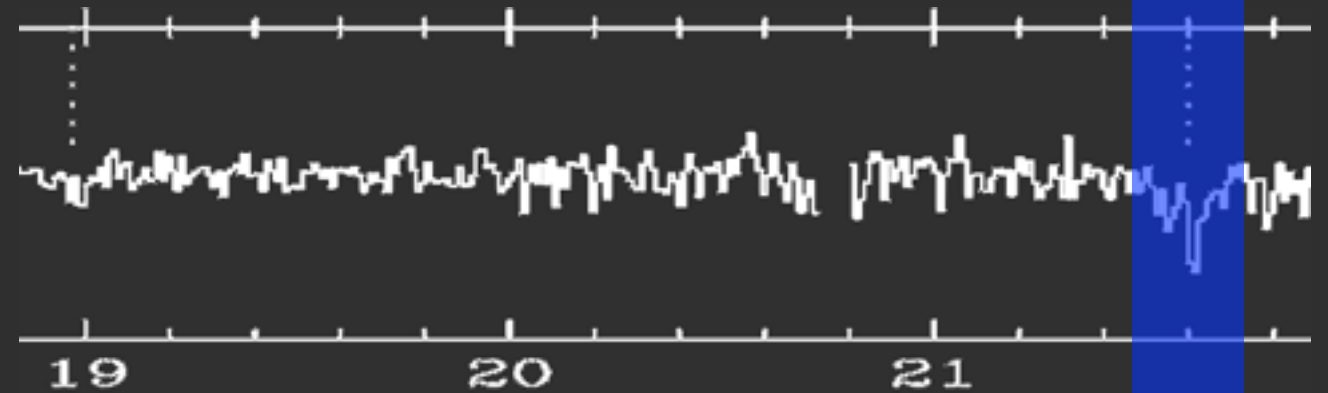
CHANDRA LETG



FANG ET AL. (2007)

XMM RGS

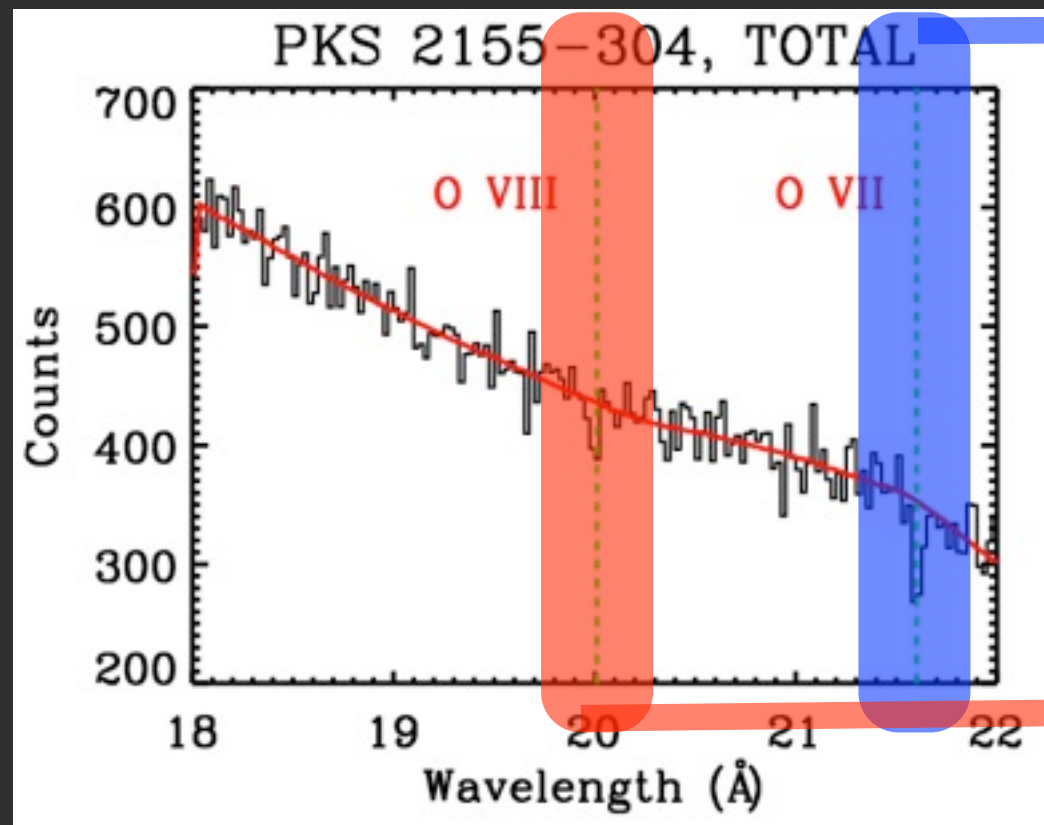
$Z = 0$



RASMUSSEN ET AL. (2003)

ISSUE 1: INCONSISTENCY BETWEEN INSTRUMENTS

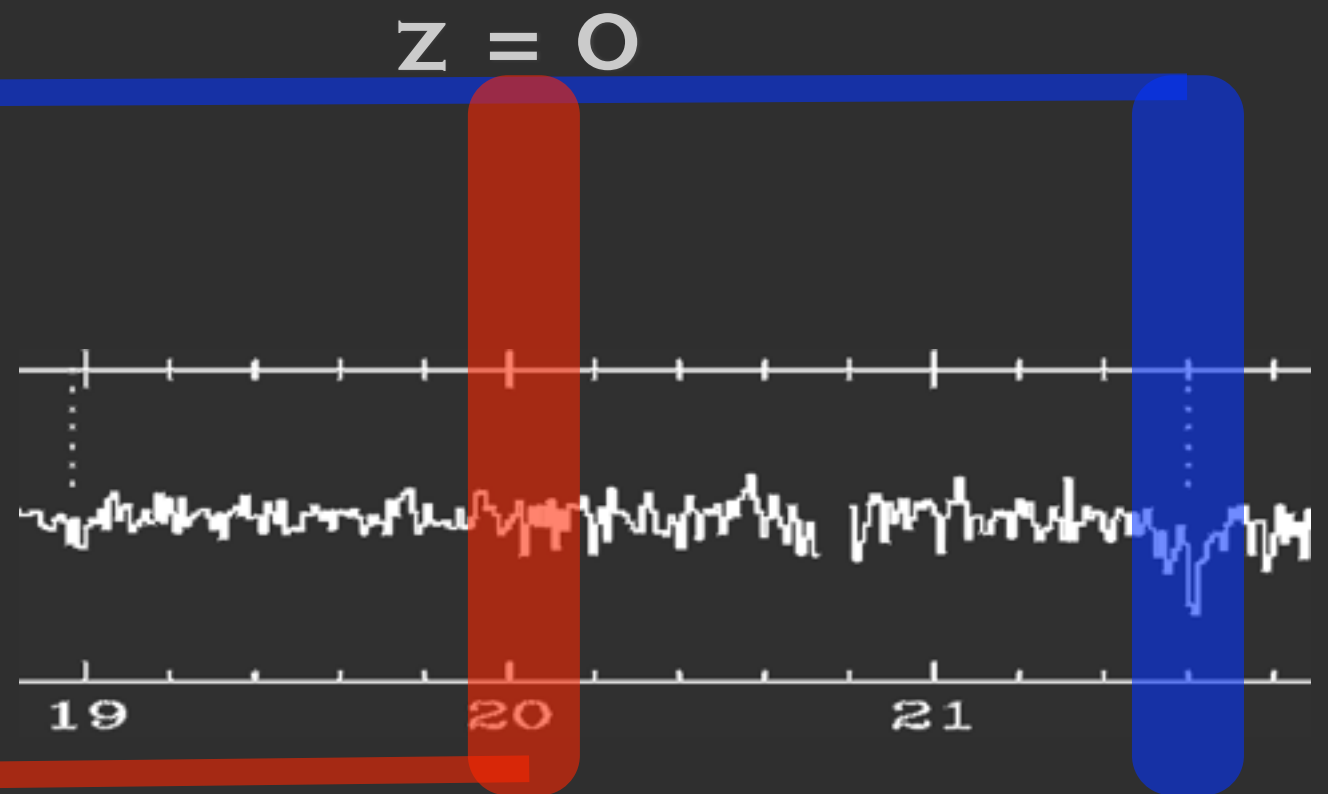
CHANDRA LETG



$z = 0.055$

FANG ET AL. (2007)

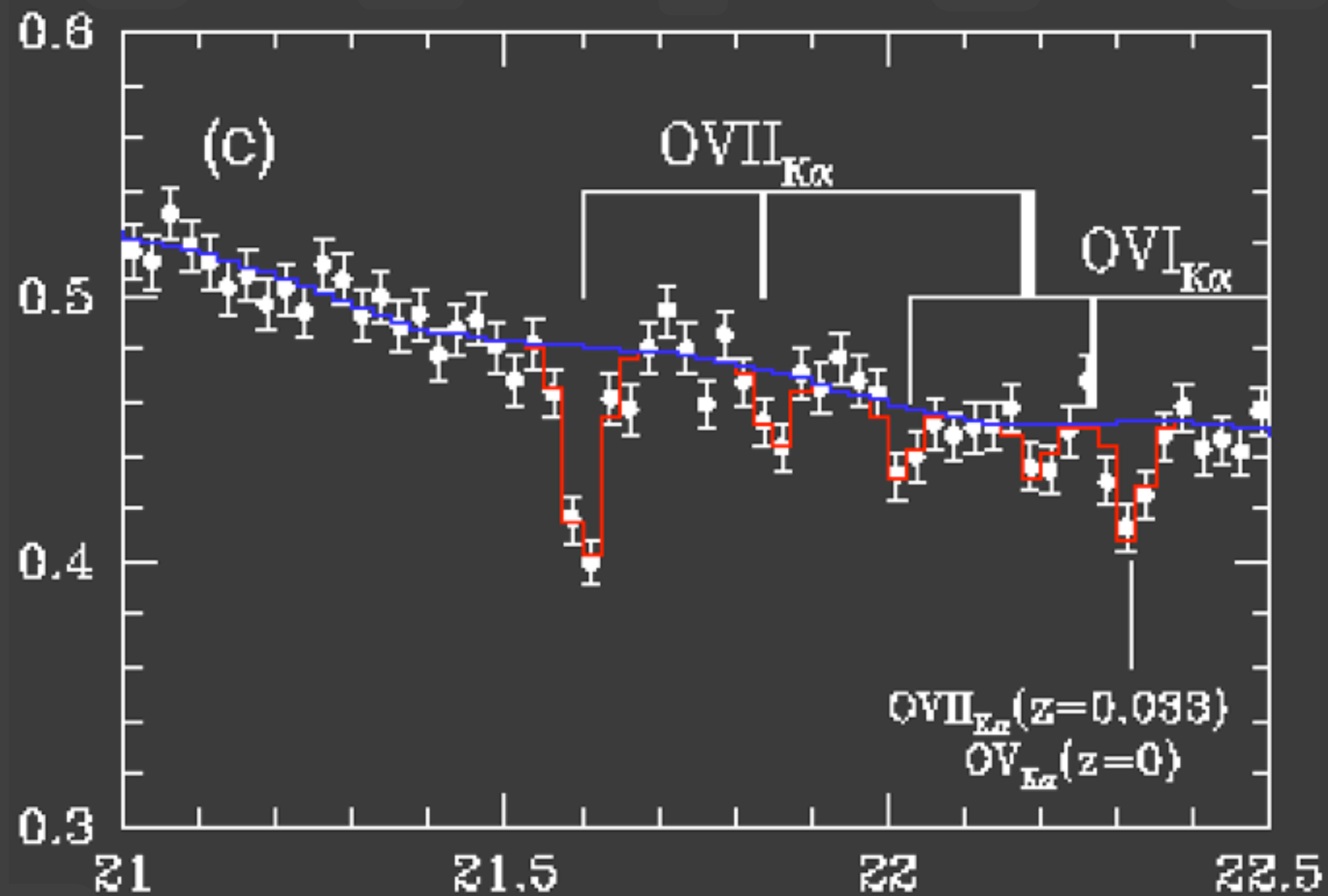
XMM RGS



RASMUSSEN ET AL. (2003)

ISSUE 2: STATISTICS

MKN 421, CHANDRA

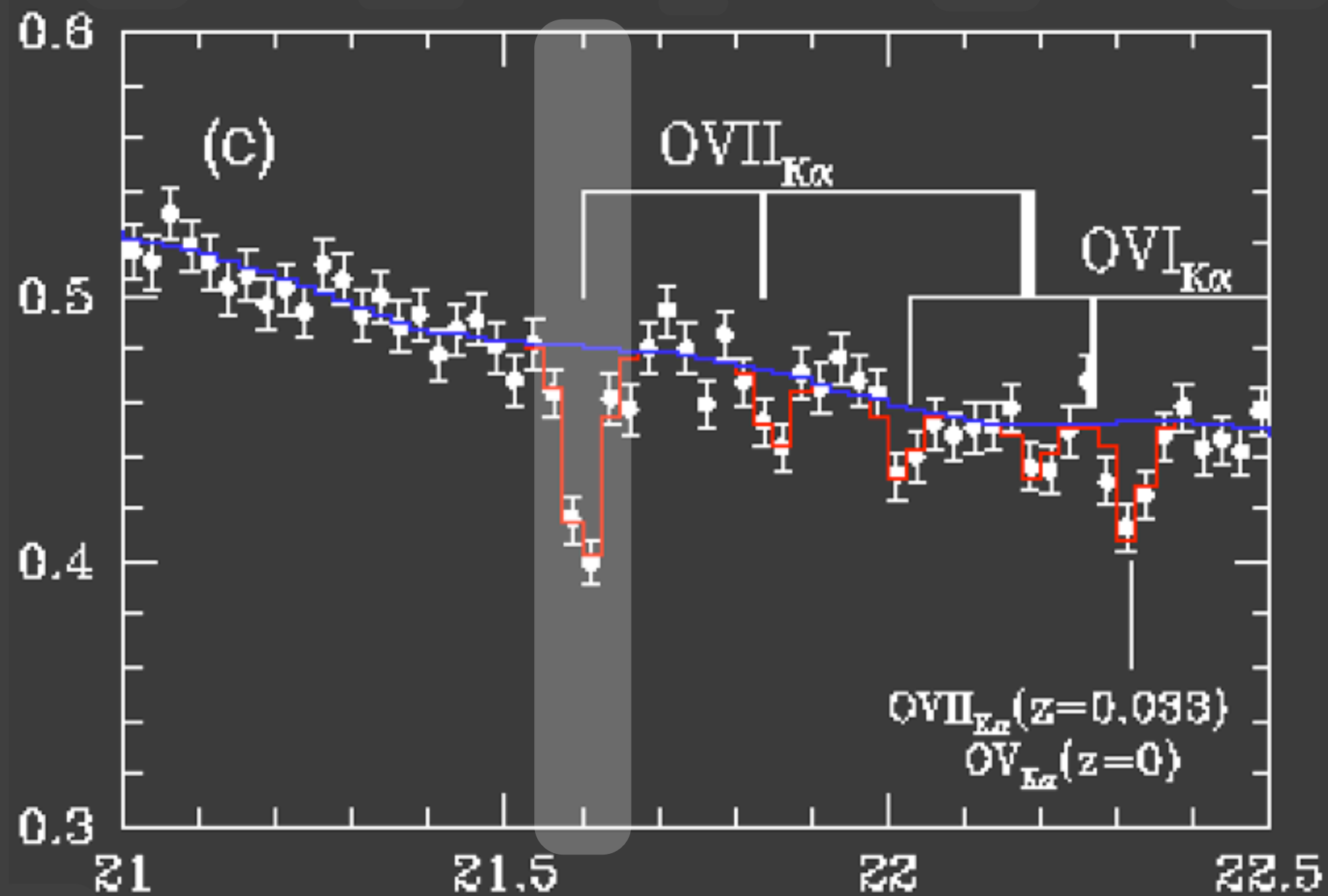


NICASTRO ET AL. (2005)

KAASTRA ET AL. (2007)

ISSUE 2: STATISTICS

MKN 421, CHANDRA

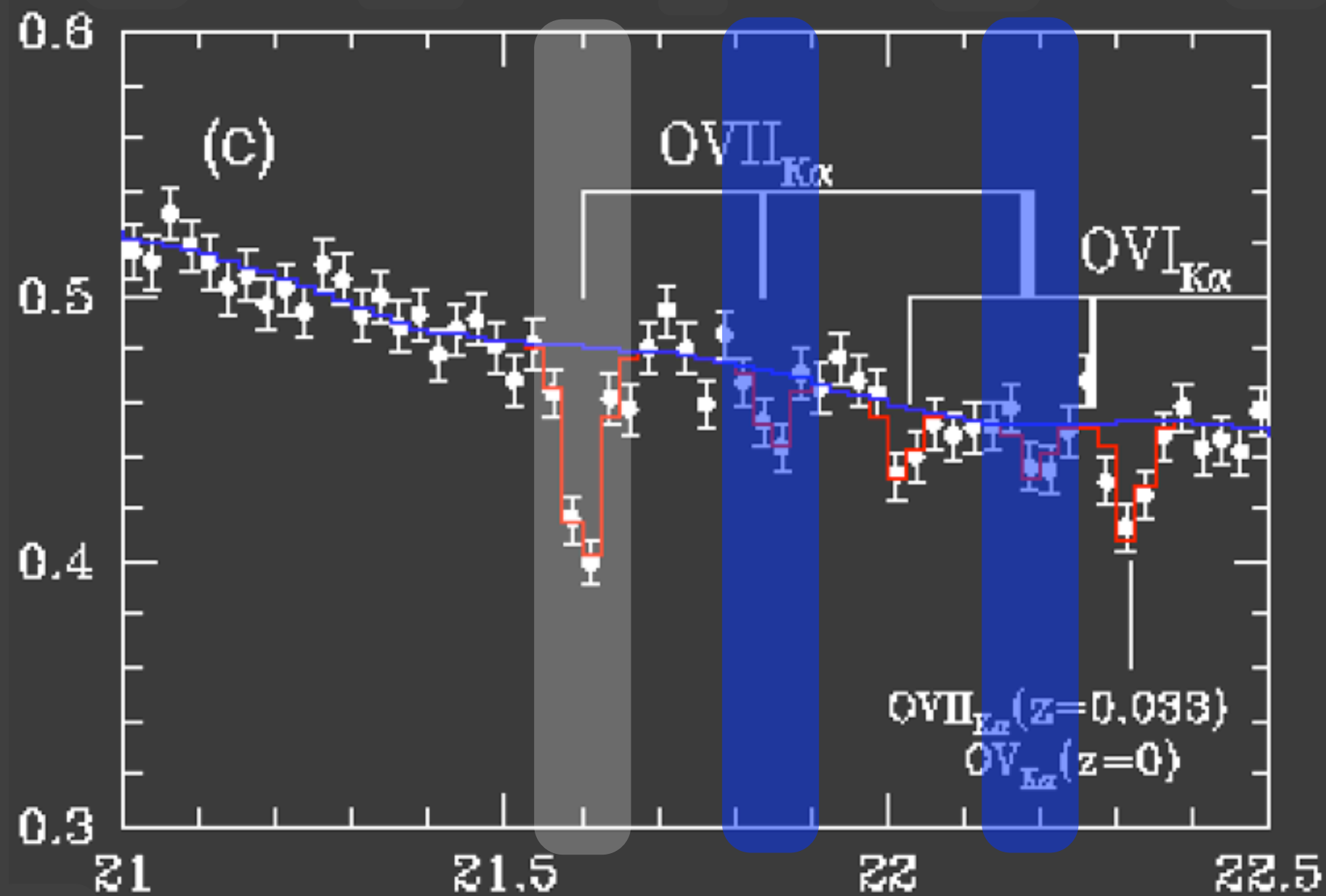


NICASTRO ET AL. (2005)

KAASTRA ET AL. (2007)

ISSUE 2: STATISTICS

MKN 421, CHANDRA



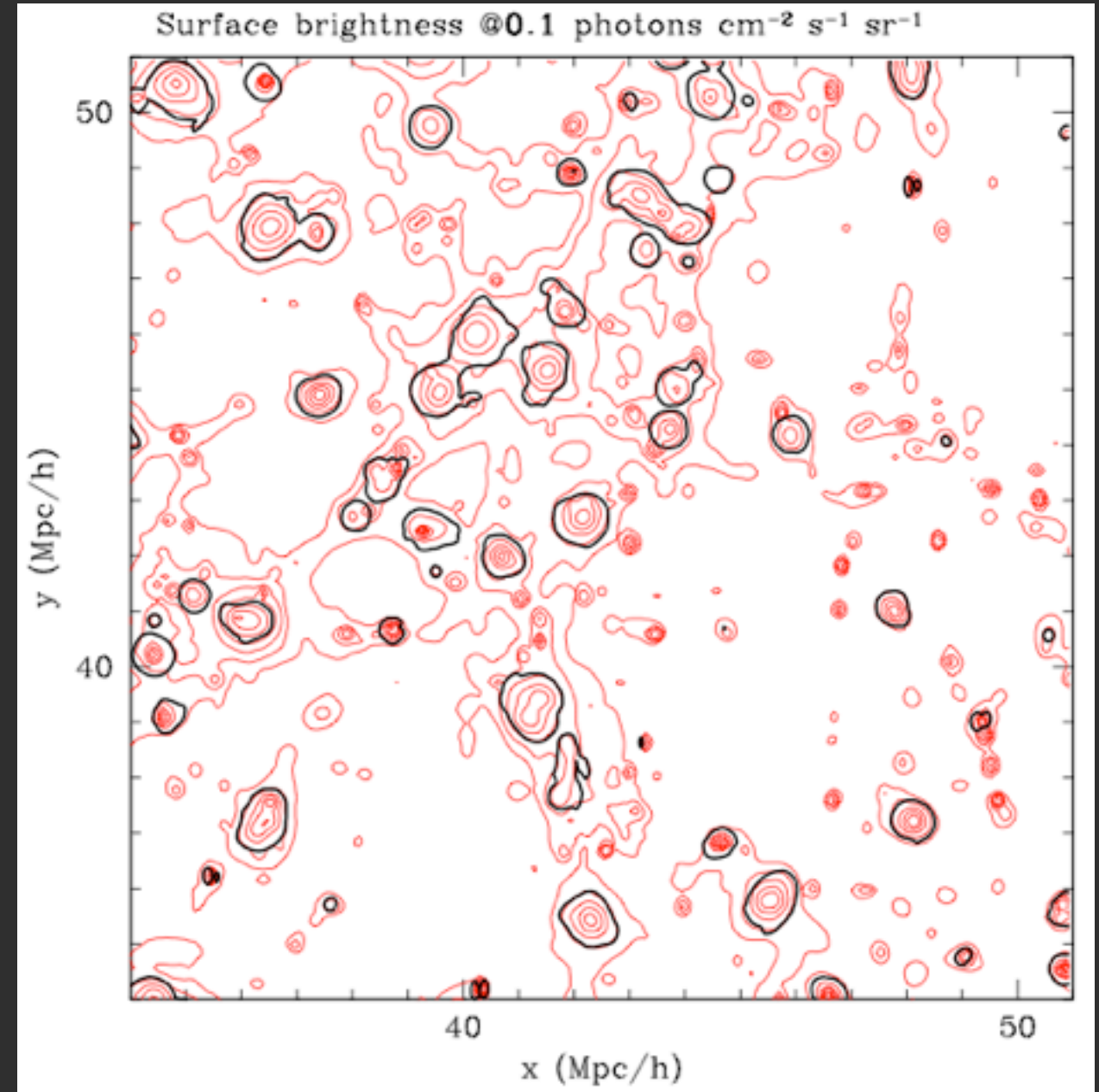
NICASTRO ET AL. (2005)

KAASTRA ET AL. (2007)

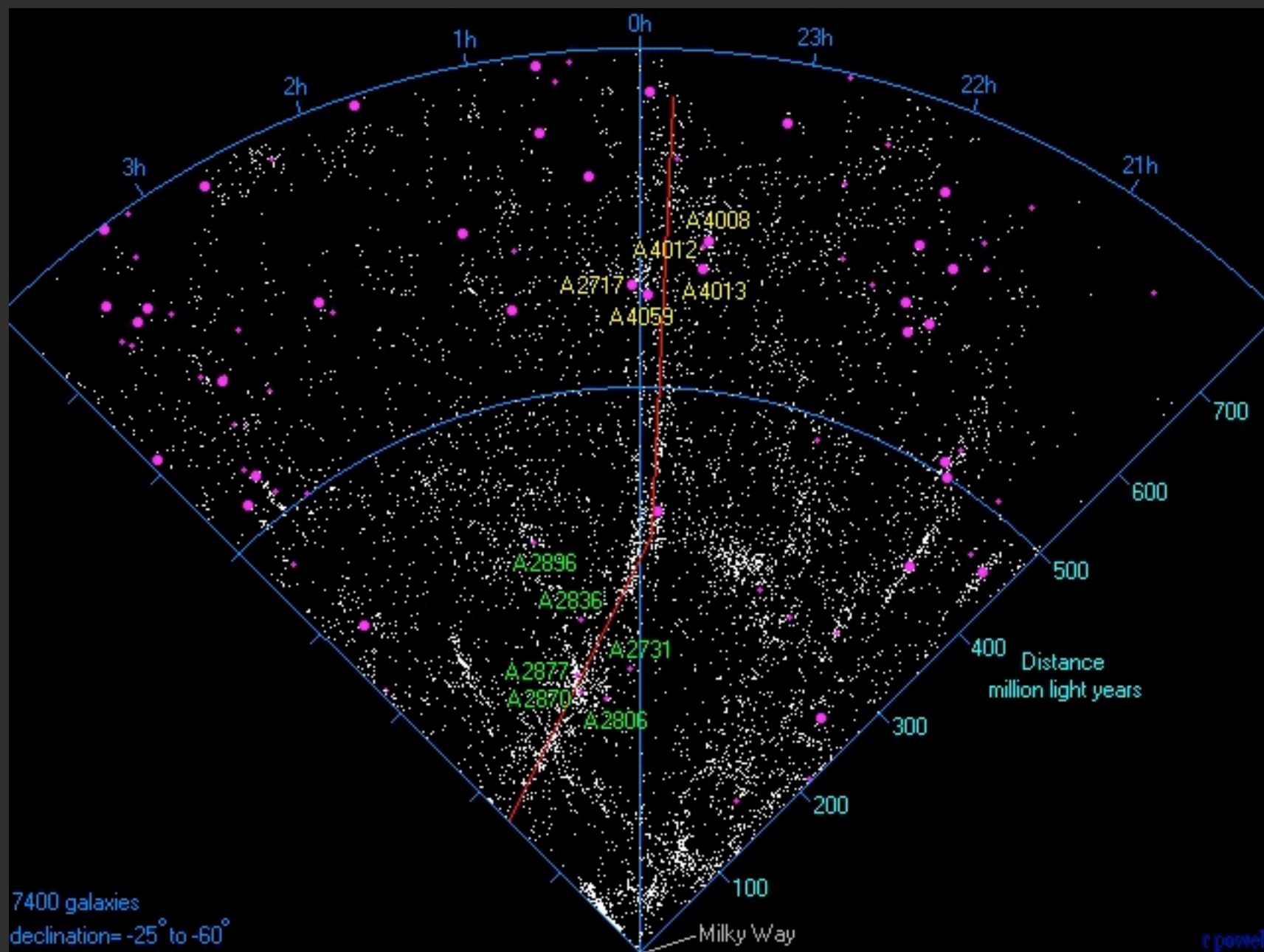
SOLUTION:

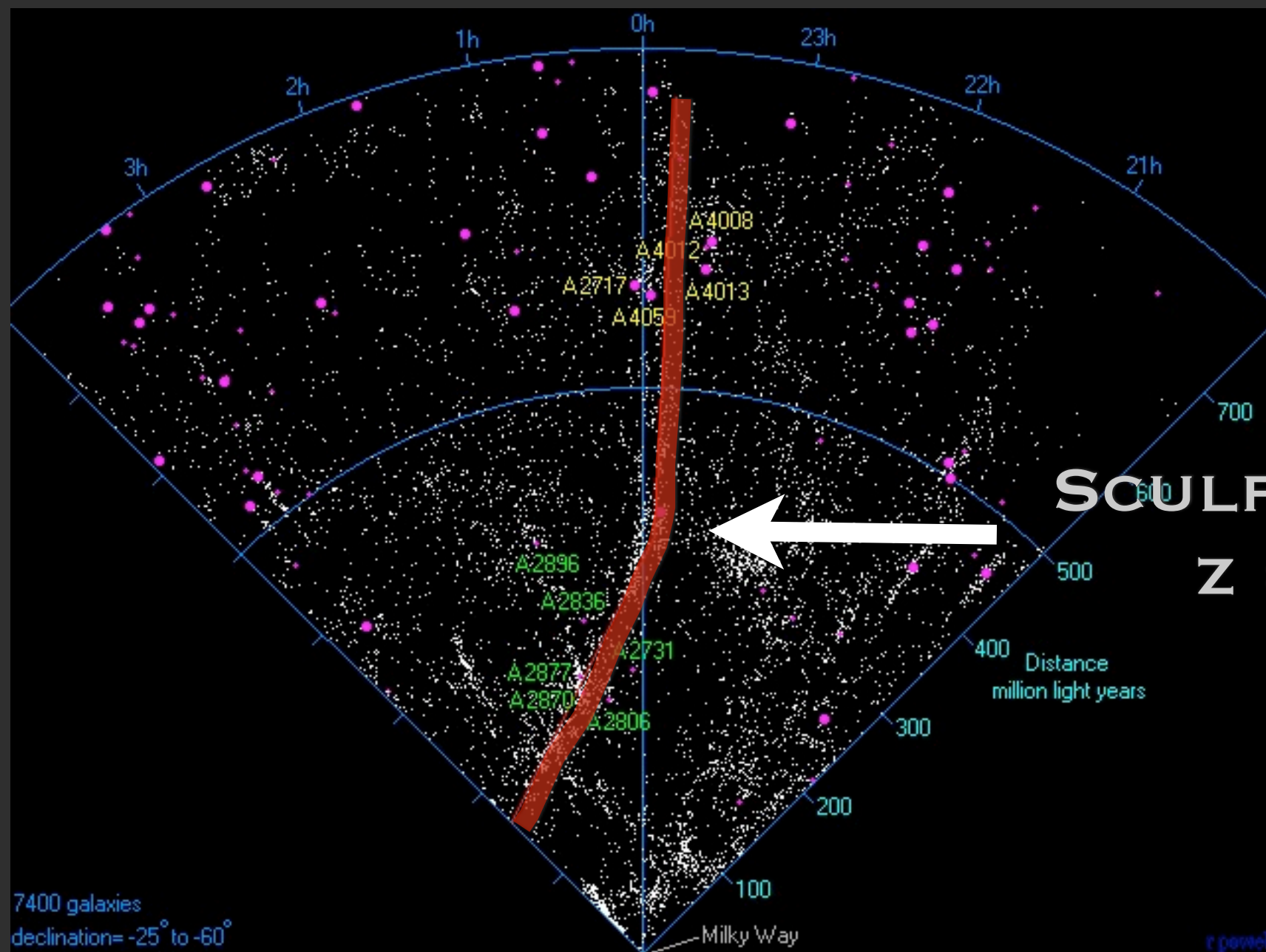
✓ **JOINT
DETECTION WITH
CHANDRA AND
XMM**

✓ **“TARGETED”
SEARCH**

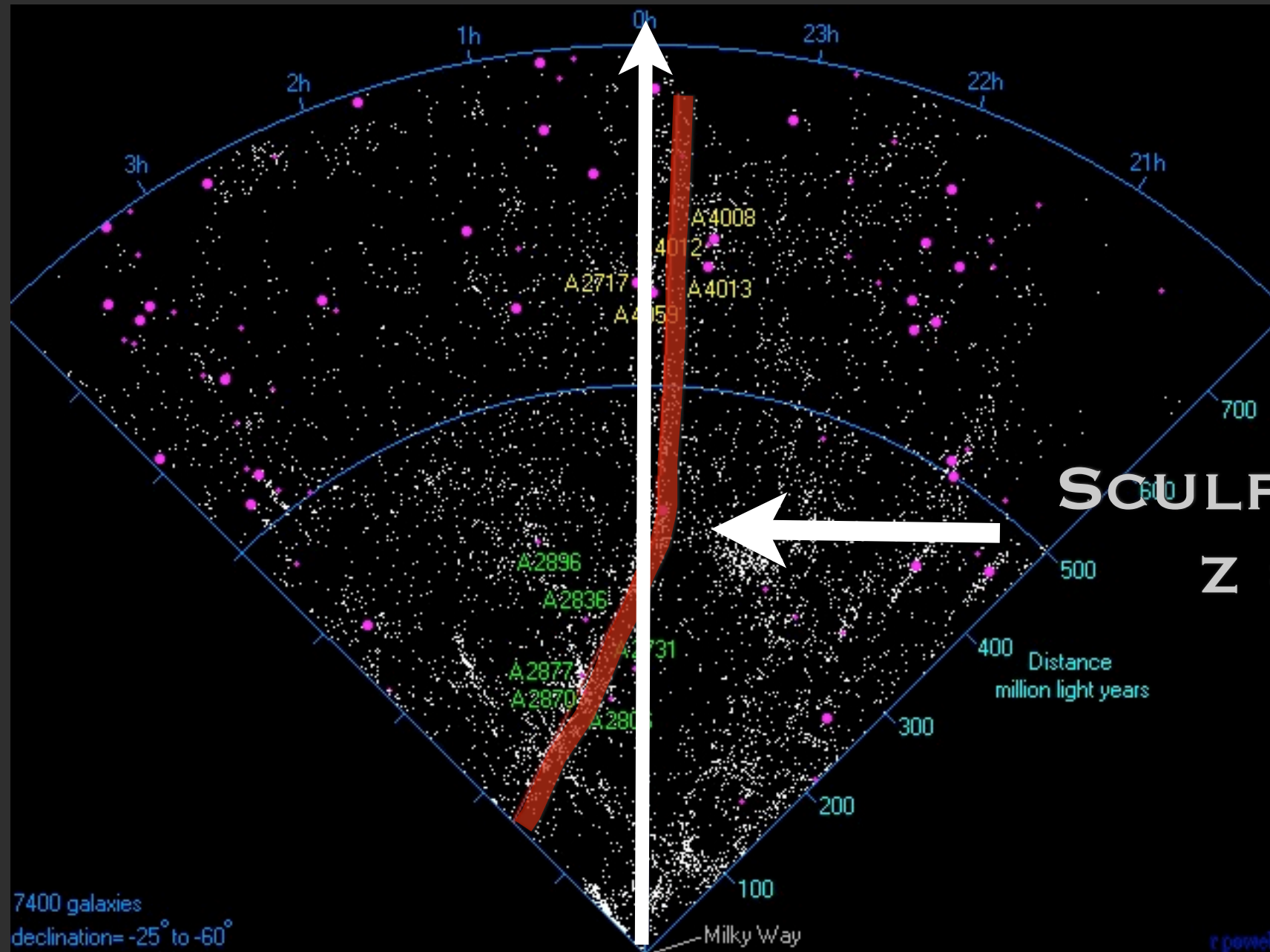


CEN & FANG (2006)





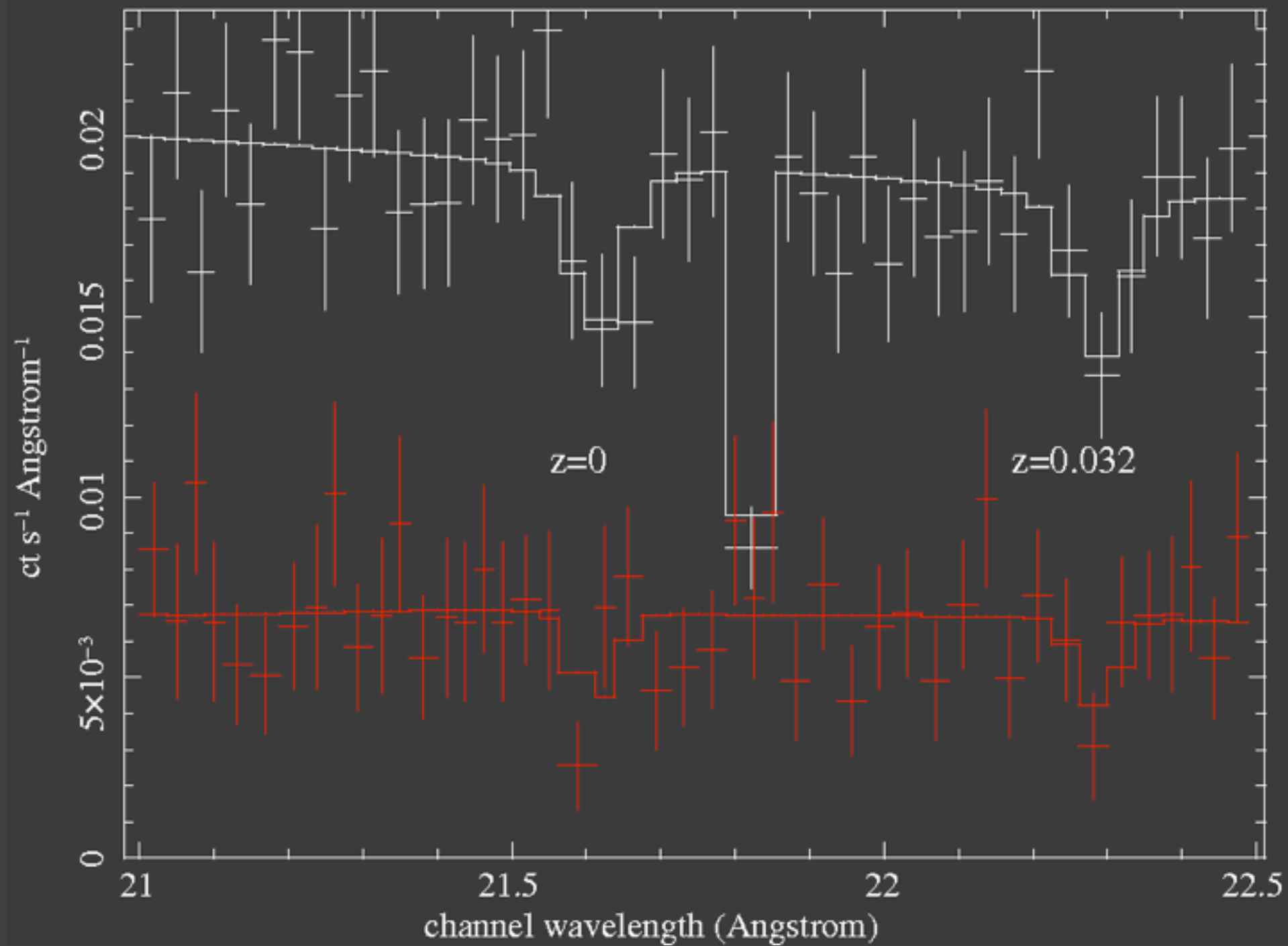
H 2356-309



SCULPTOR WALL
 $z = 0.03$

CHANDRA: 100 KSEC; XMM RGS: 130 KSEC

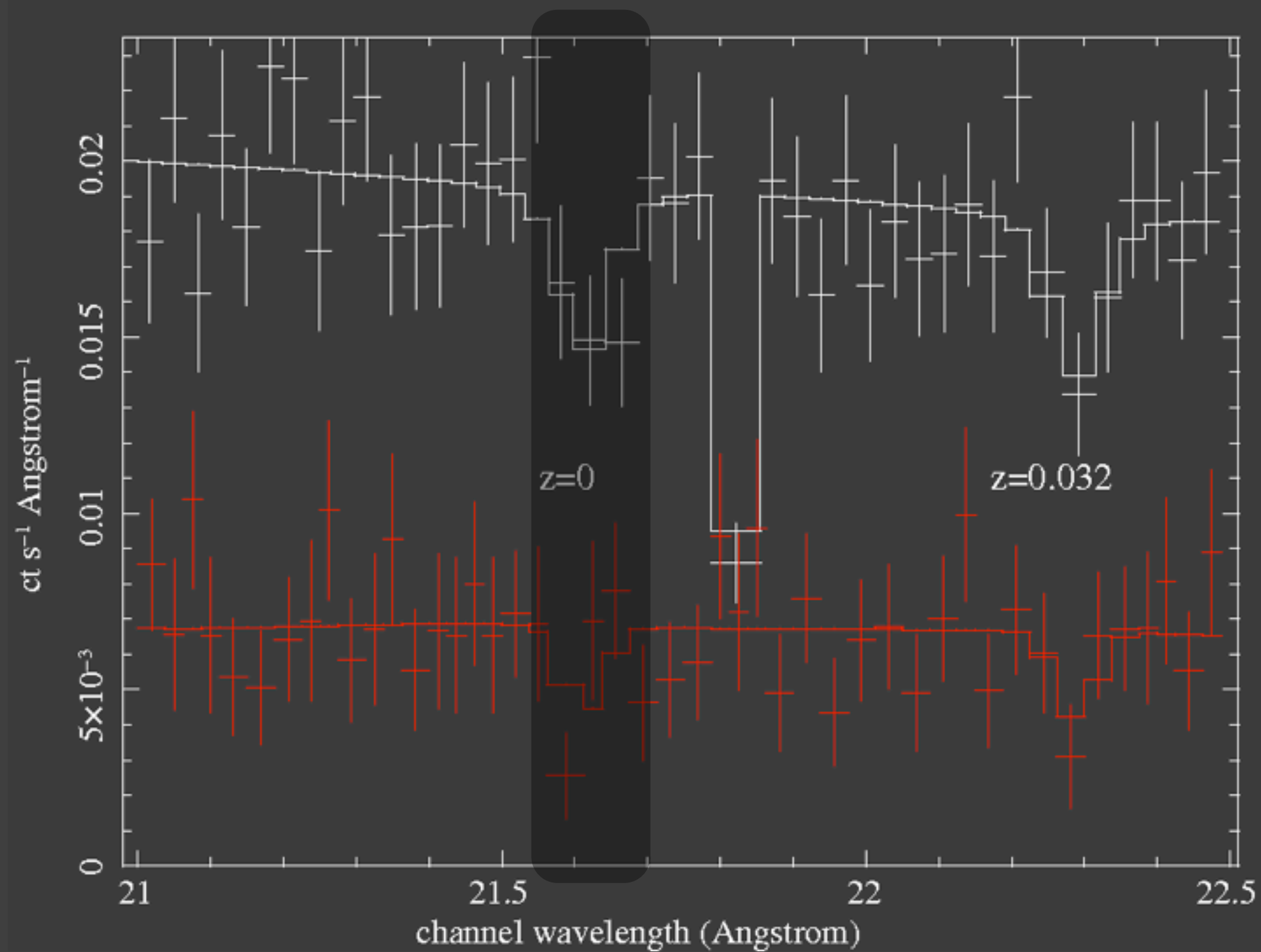
data and folded model



BUOTE ET AL. (2009)

CHANDRA: 100 KSEC; XMM RGS: 130 KSEC

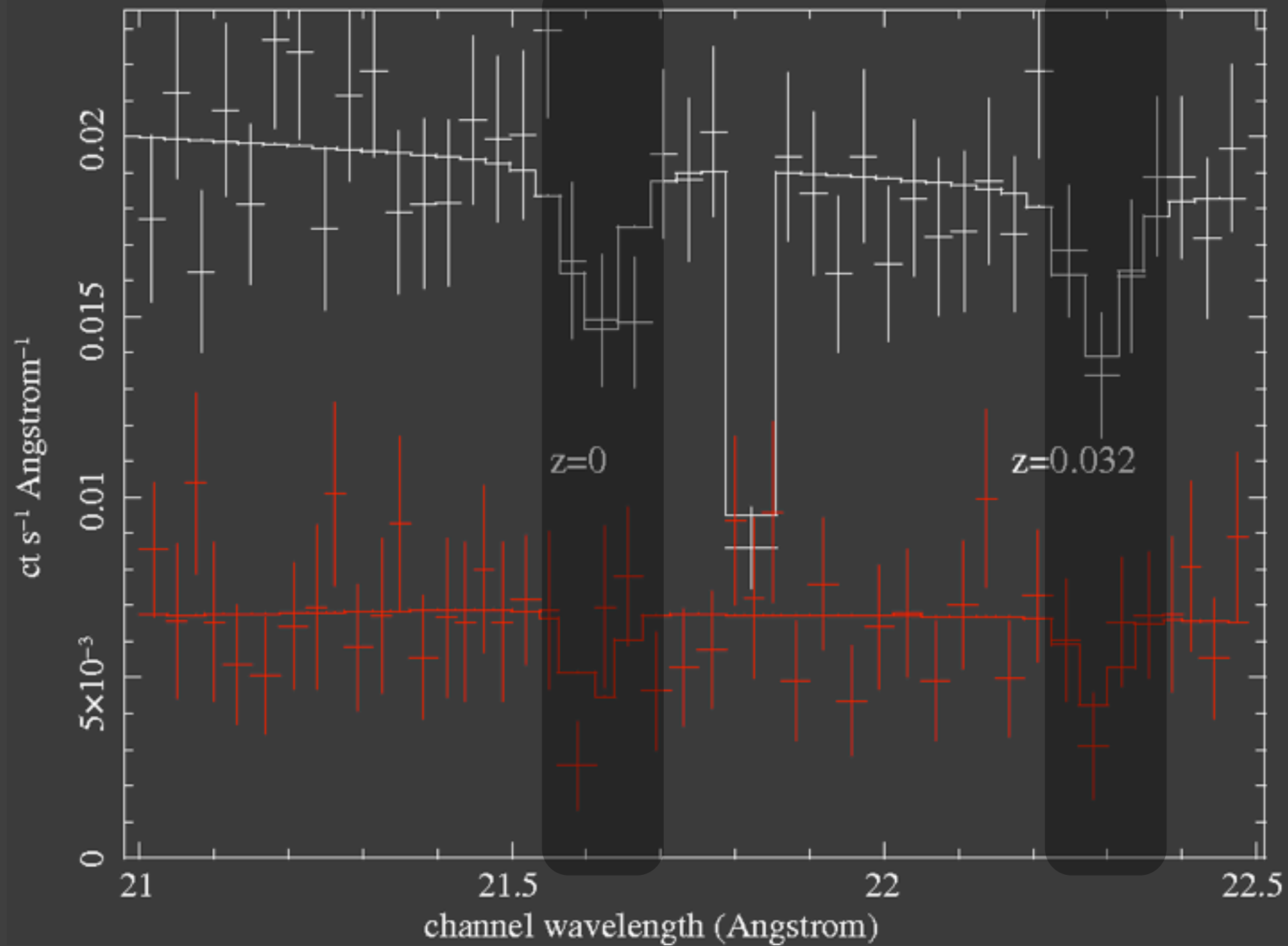
data and folded model



BUOTE ET AL. (2009)

CHANDRA: 100 KSEC; XMM RGS: 130 KSEC

data and folded model

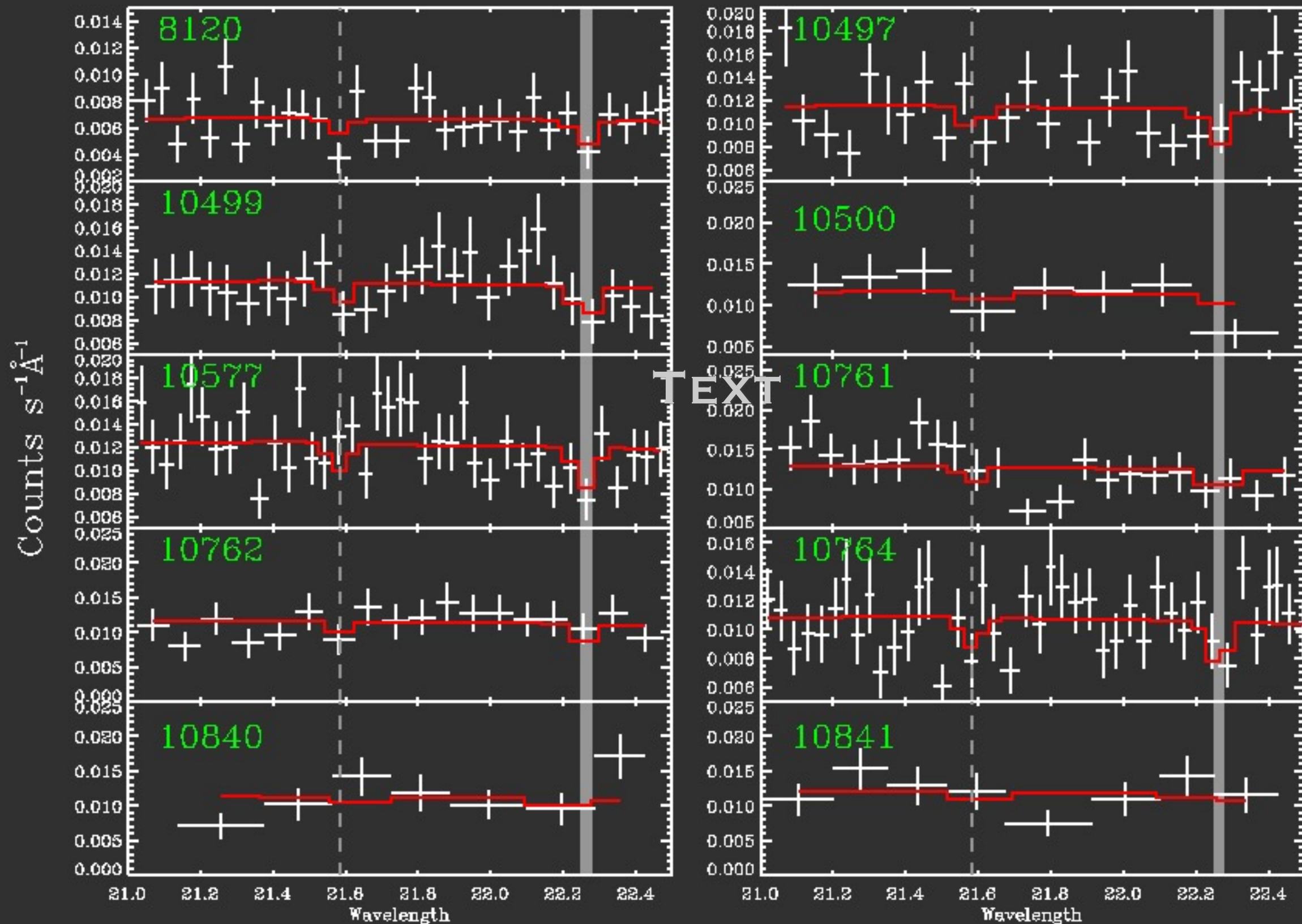


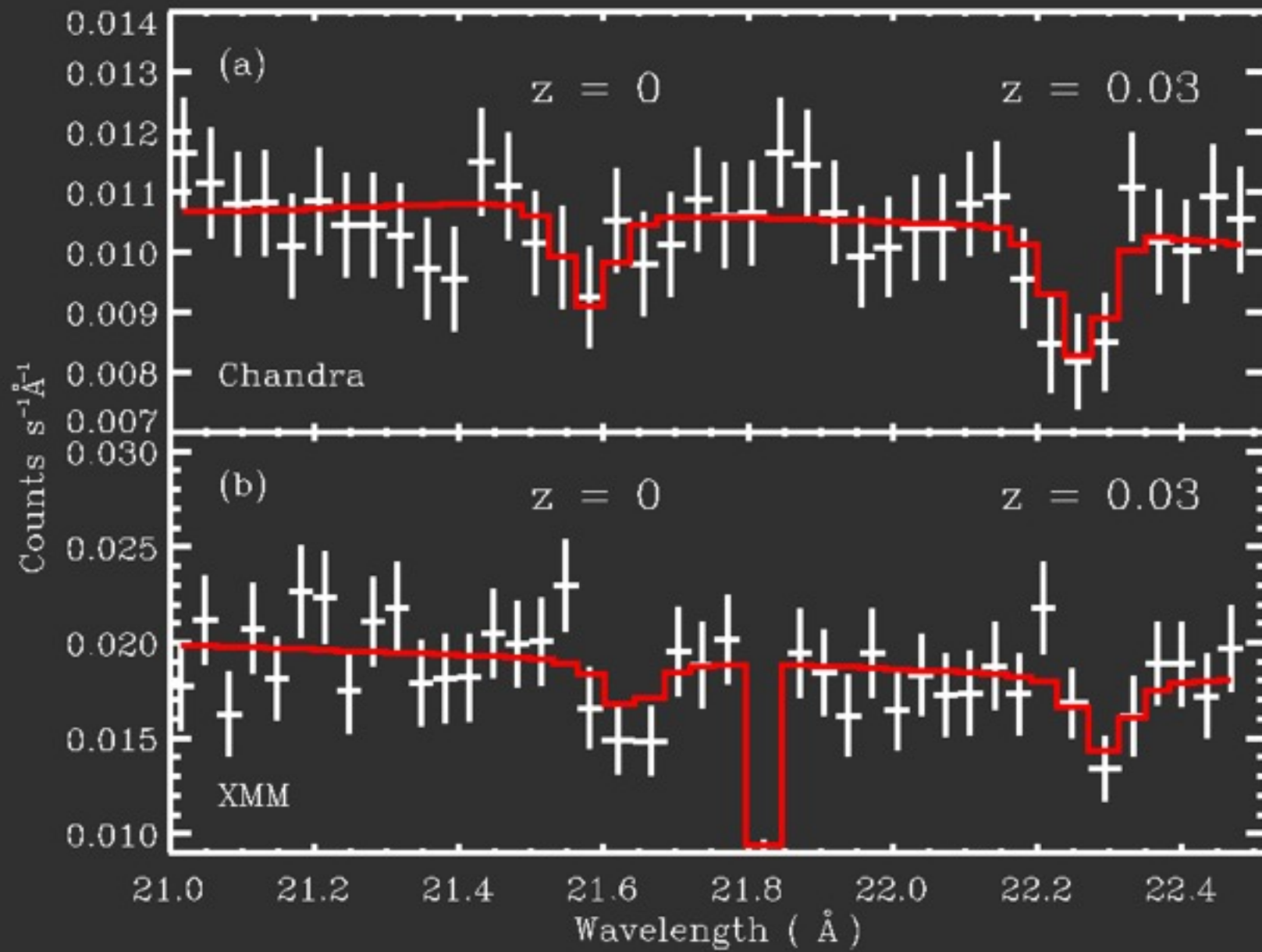
XMM
2.4-SIGMA

CHANDRA
1.7-SIGMA

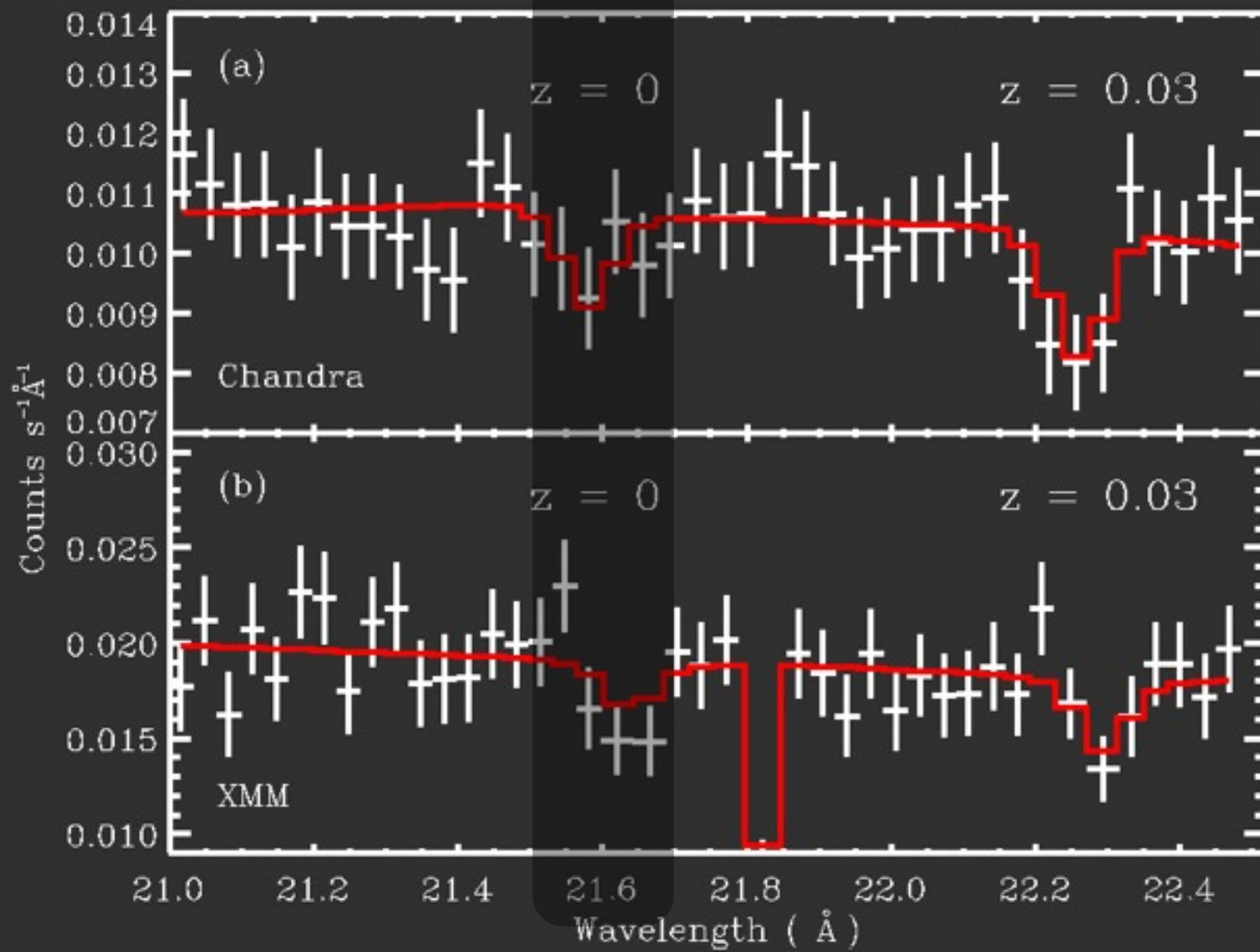
BUOTE ET AL. (2009)

CHANDRA 500 KSEC OBSERVATION

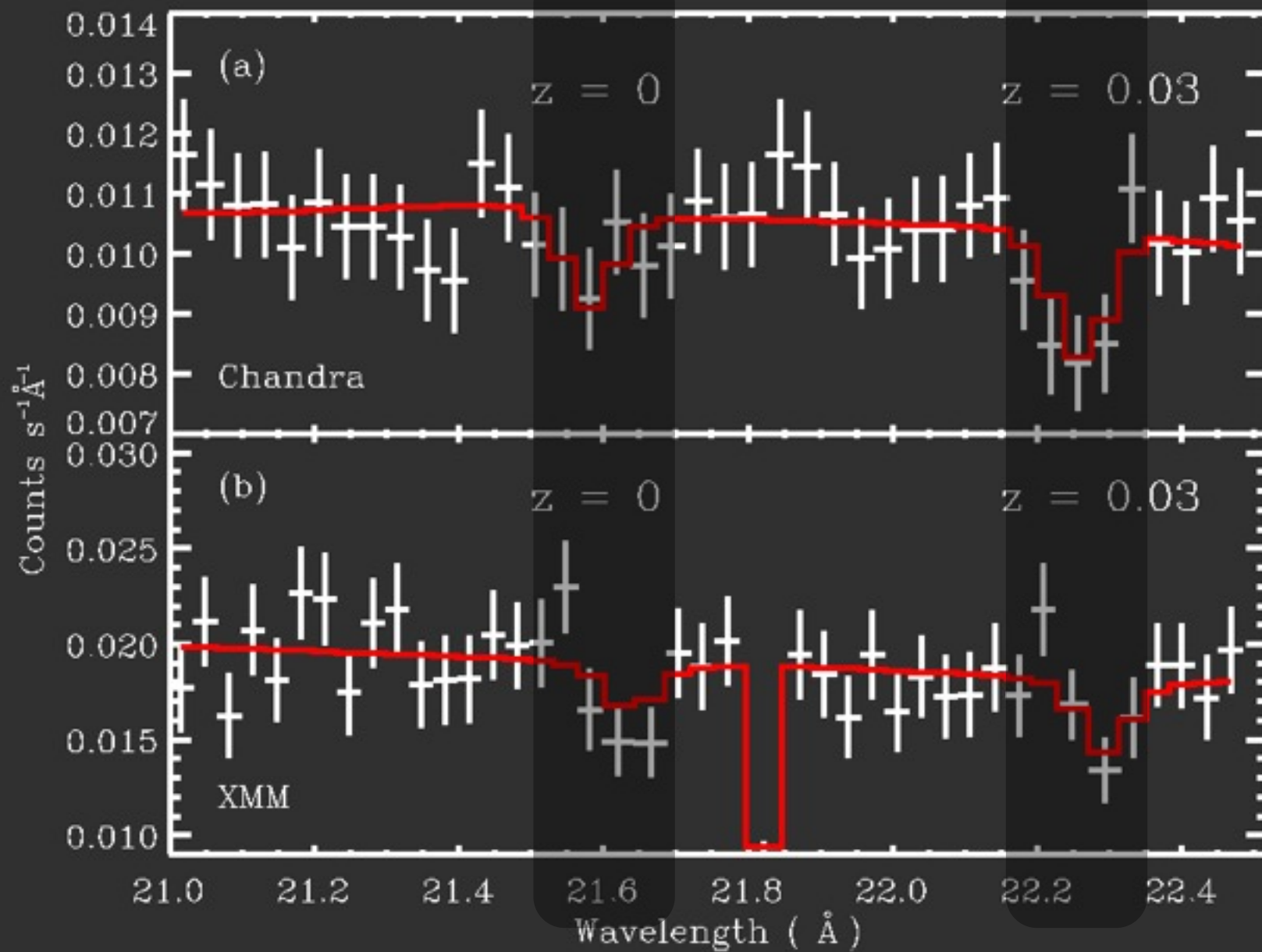




FANG ET AL. (2010)

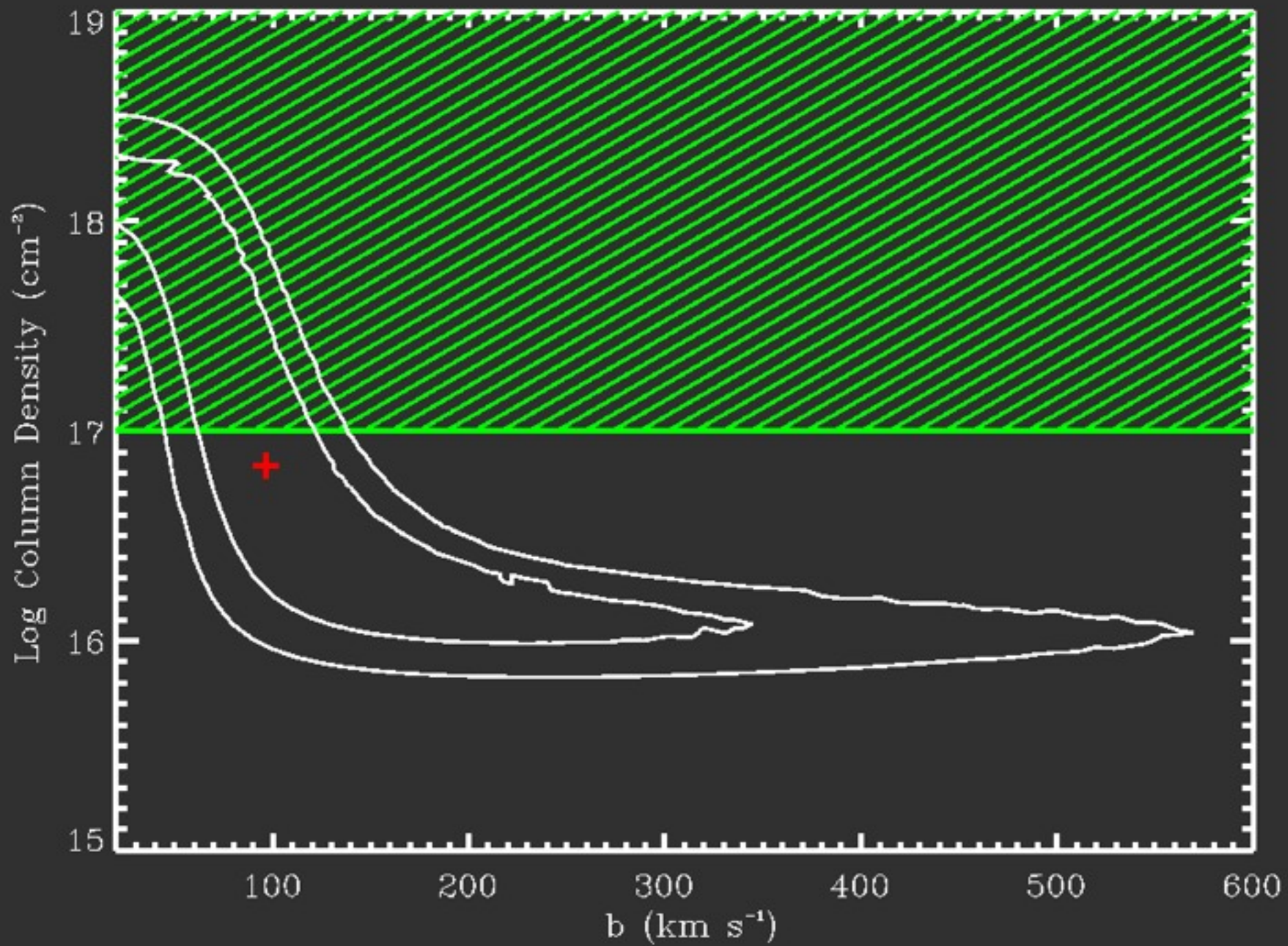


FANG ET AL. (2010)



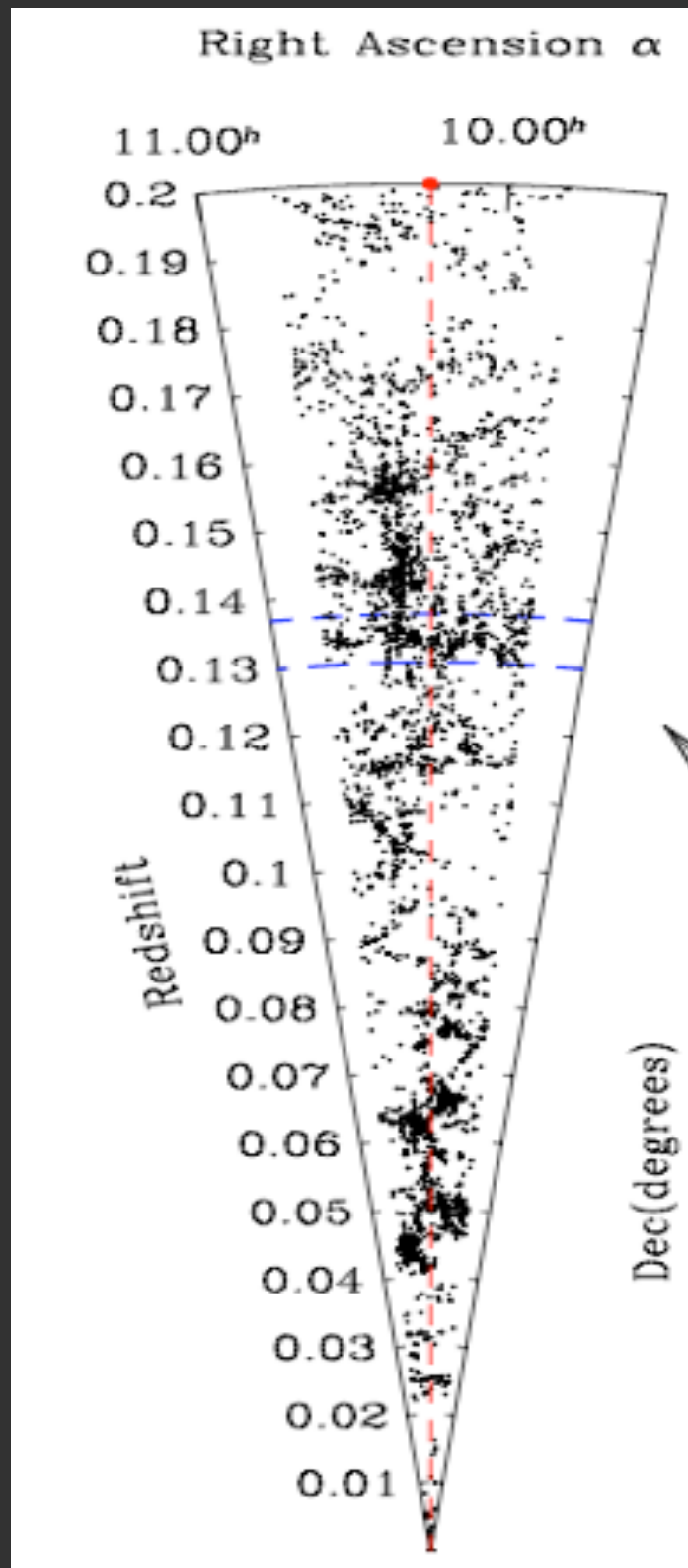
FANG ET AL. (2010)

COLUMN DENSITY

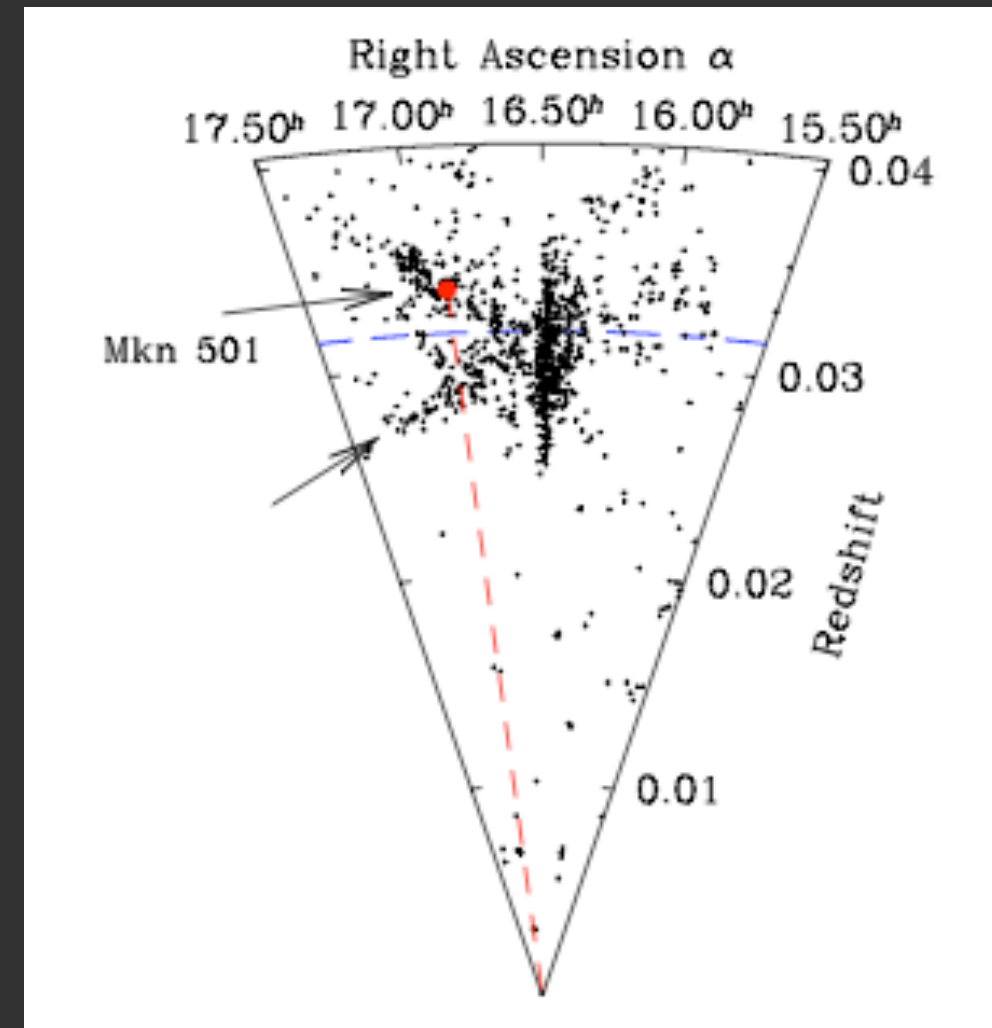


DOPPLER-B PARAMETER

1ES1011+496

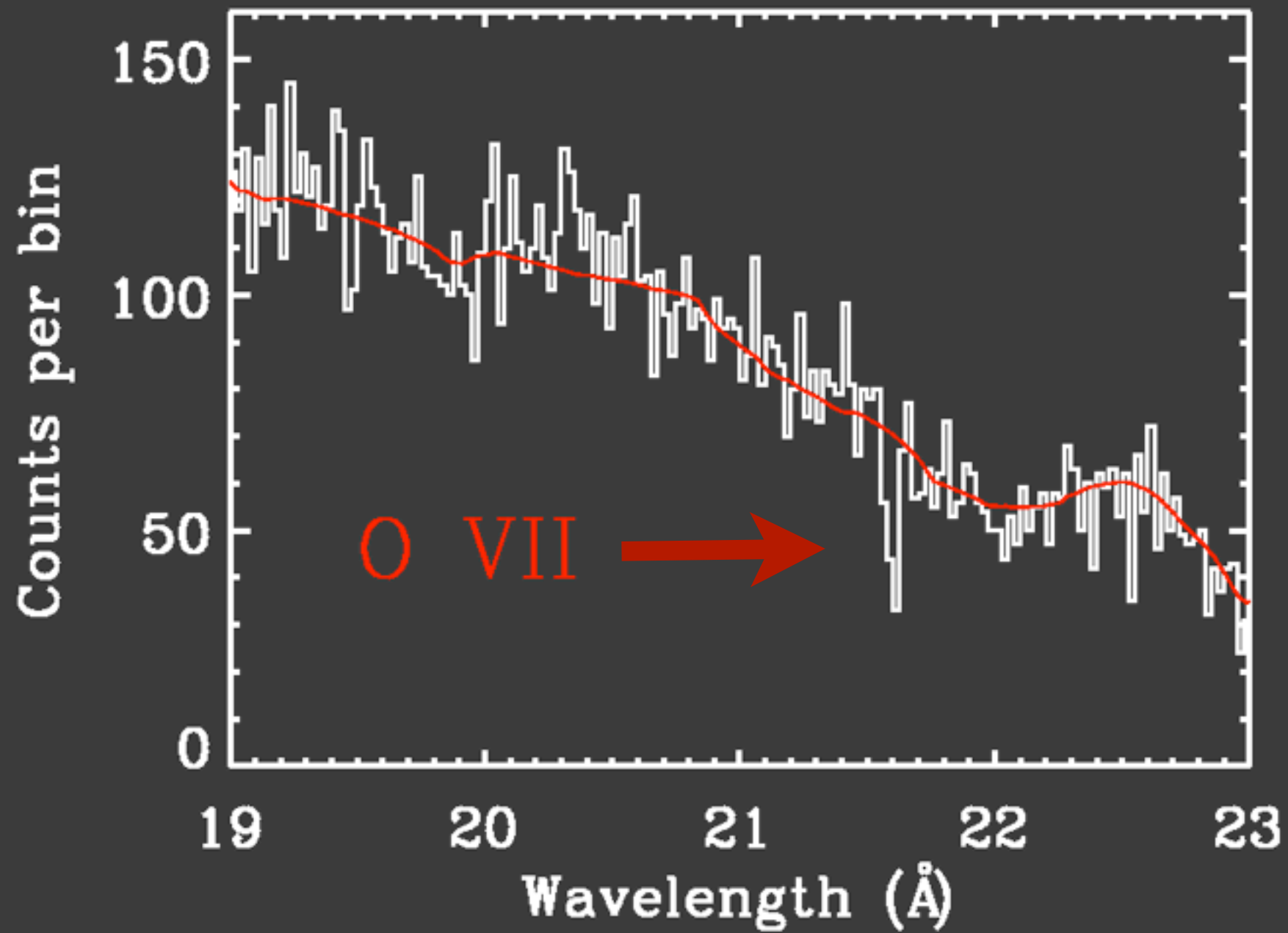


MKN 501



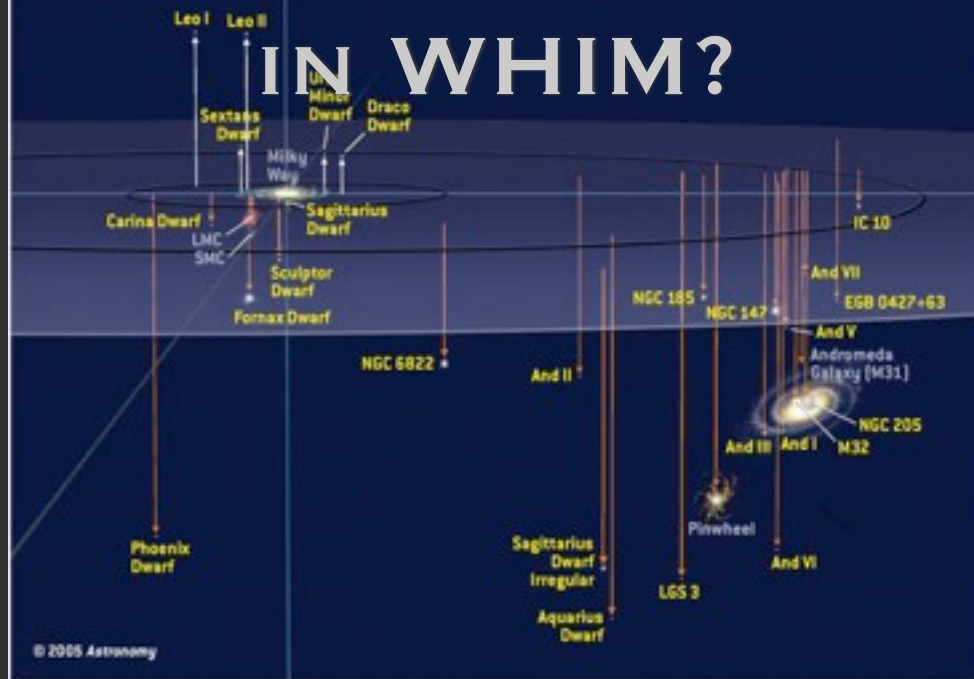
(APPROVED XMM 150 KSEC)

3C 273

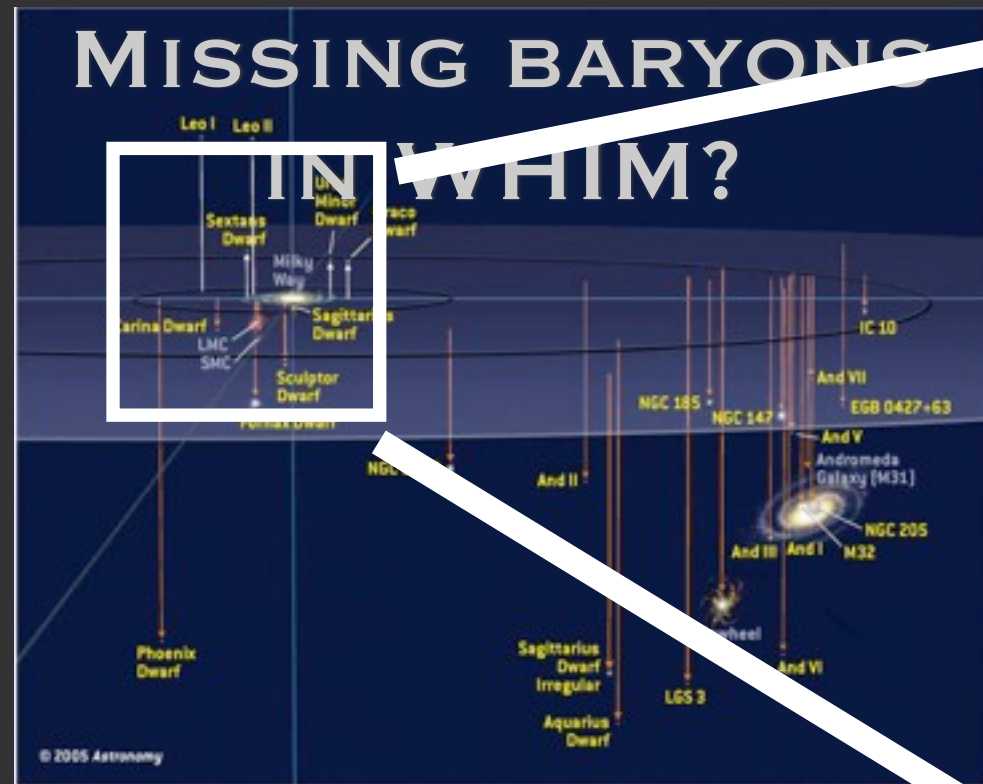


FANG ET AL. (2003)

MISSING BARYONS IN WHIM?

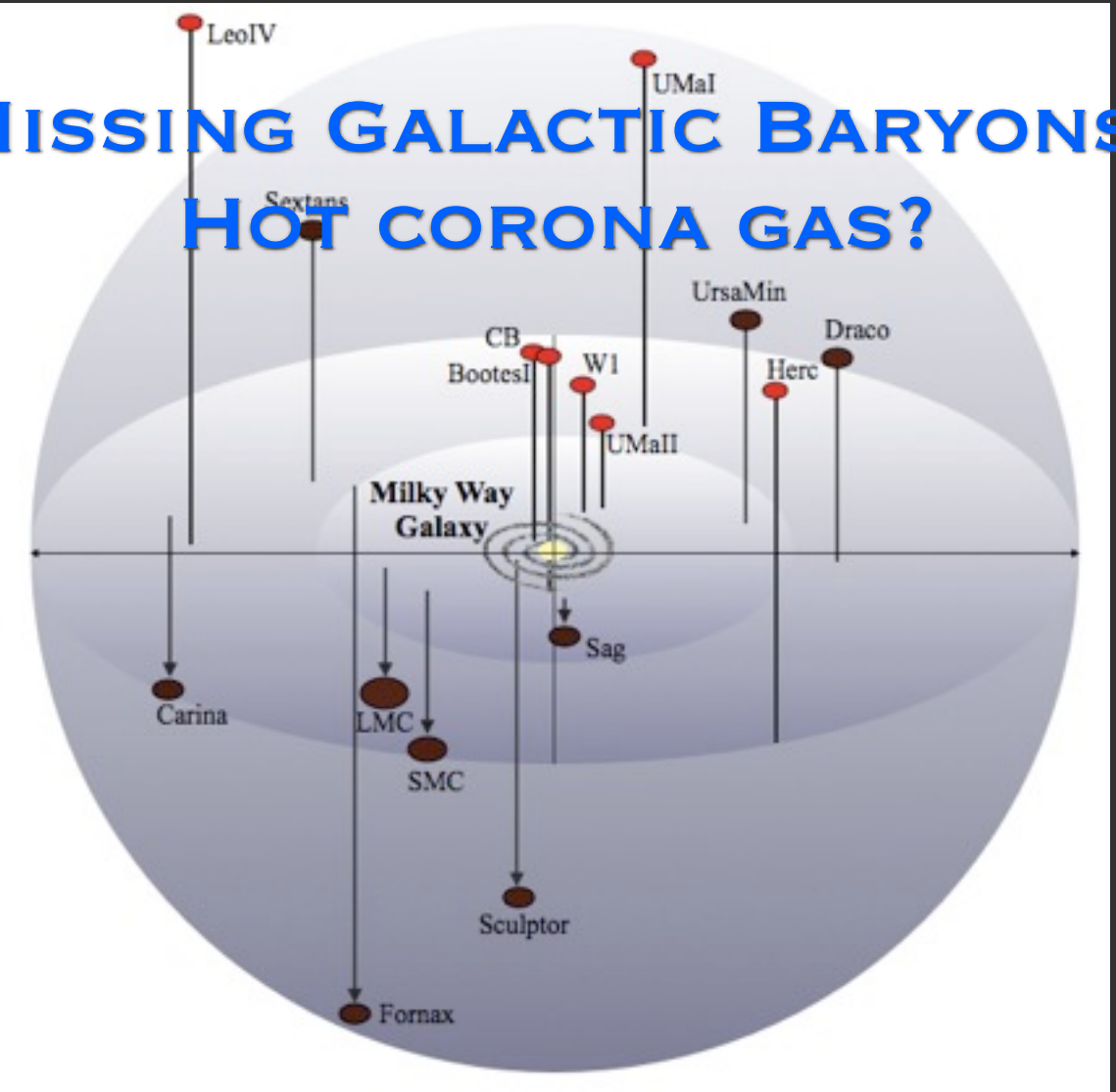


1 MPC

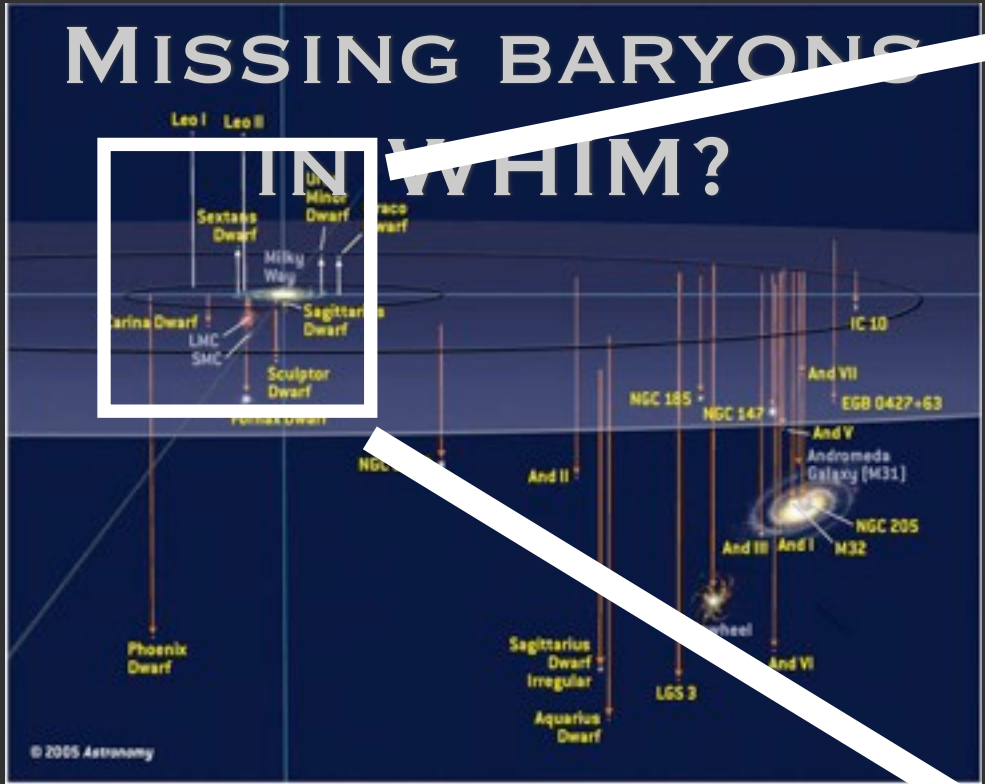


1 MPC

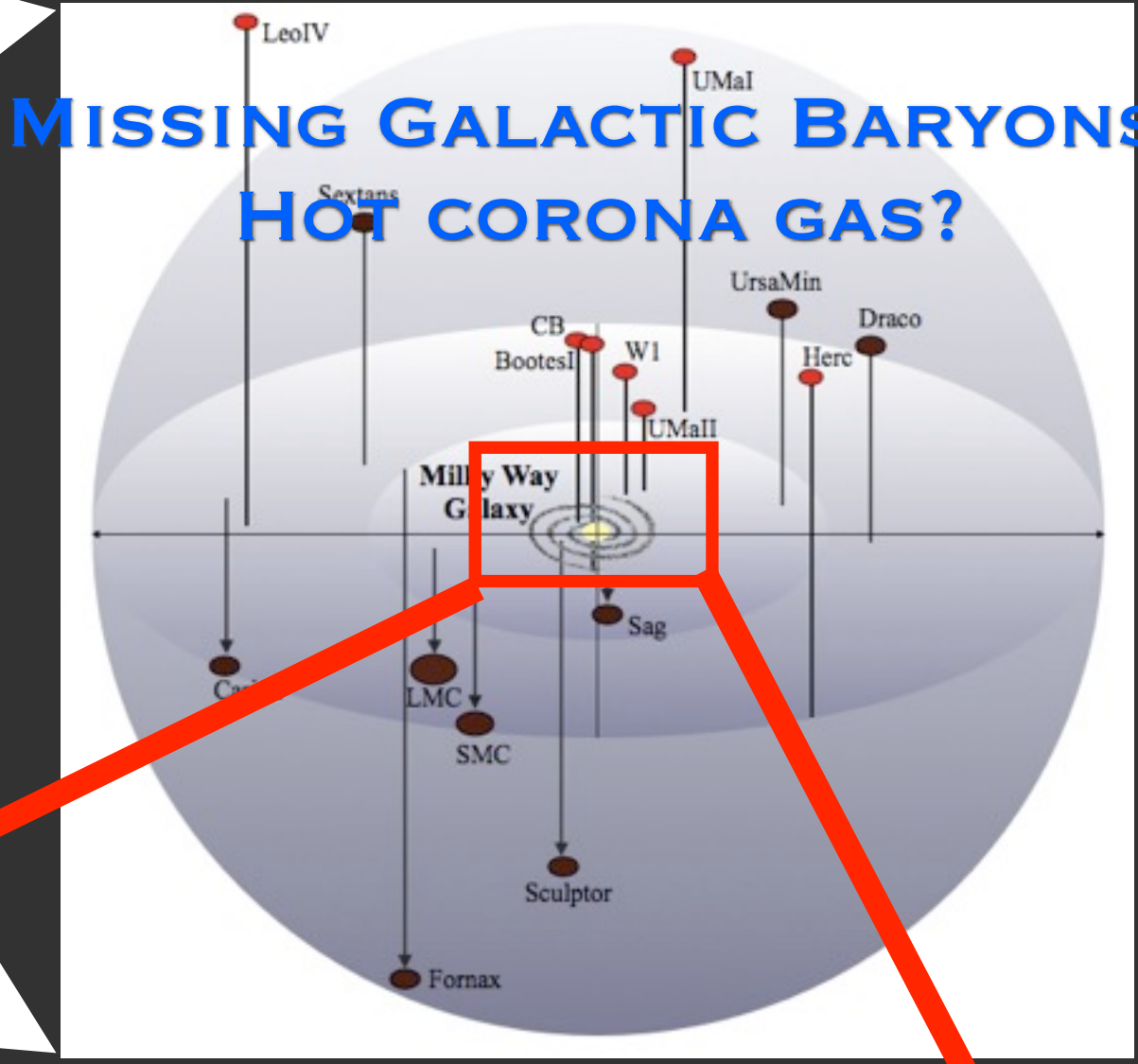
MISSING GALACTIC BARYONS, HOT CORONA GAS?



400 KPC



1 MPC



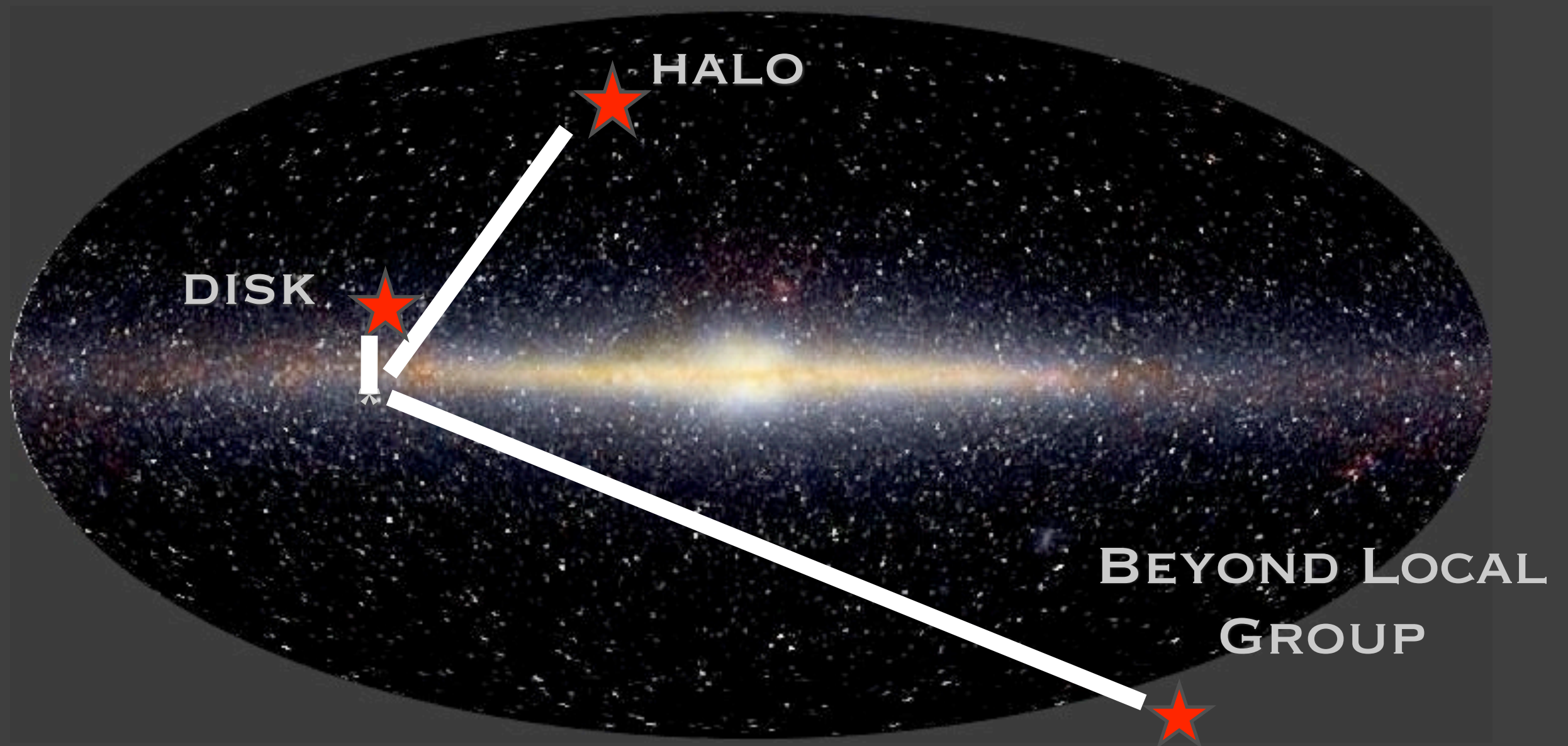
400 KPC

HOT INTERSTELLAR MEDIUM?



50 KPC

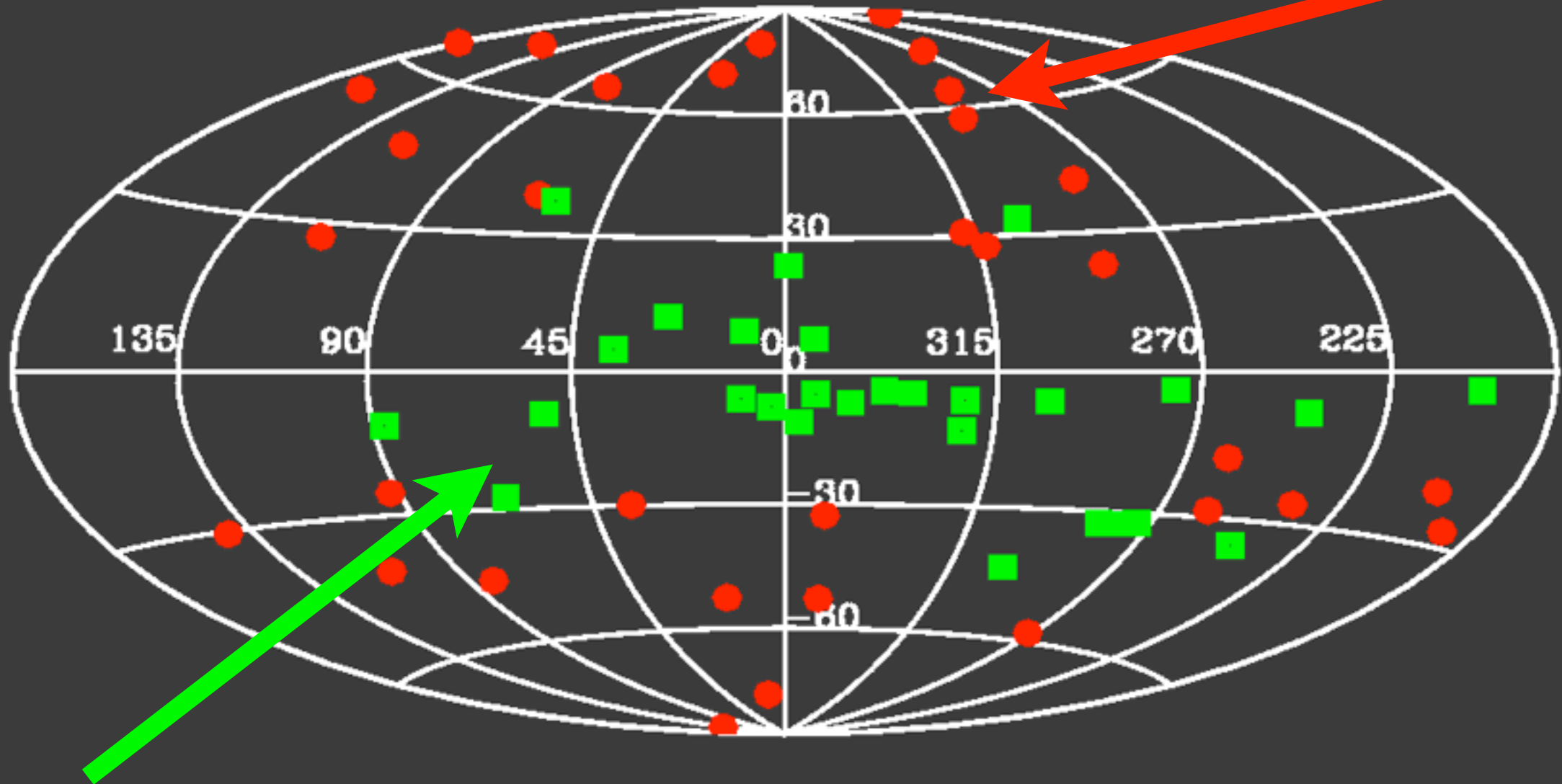
HOT GAS AROUND THE MILKY WAY: A DIFFERENTIAL DIAGNOSIS



FANG ET AL. (2010)

EXTRAGALACTIC
SOURCES

ALL SKY MAP

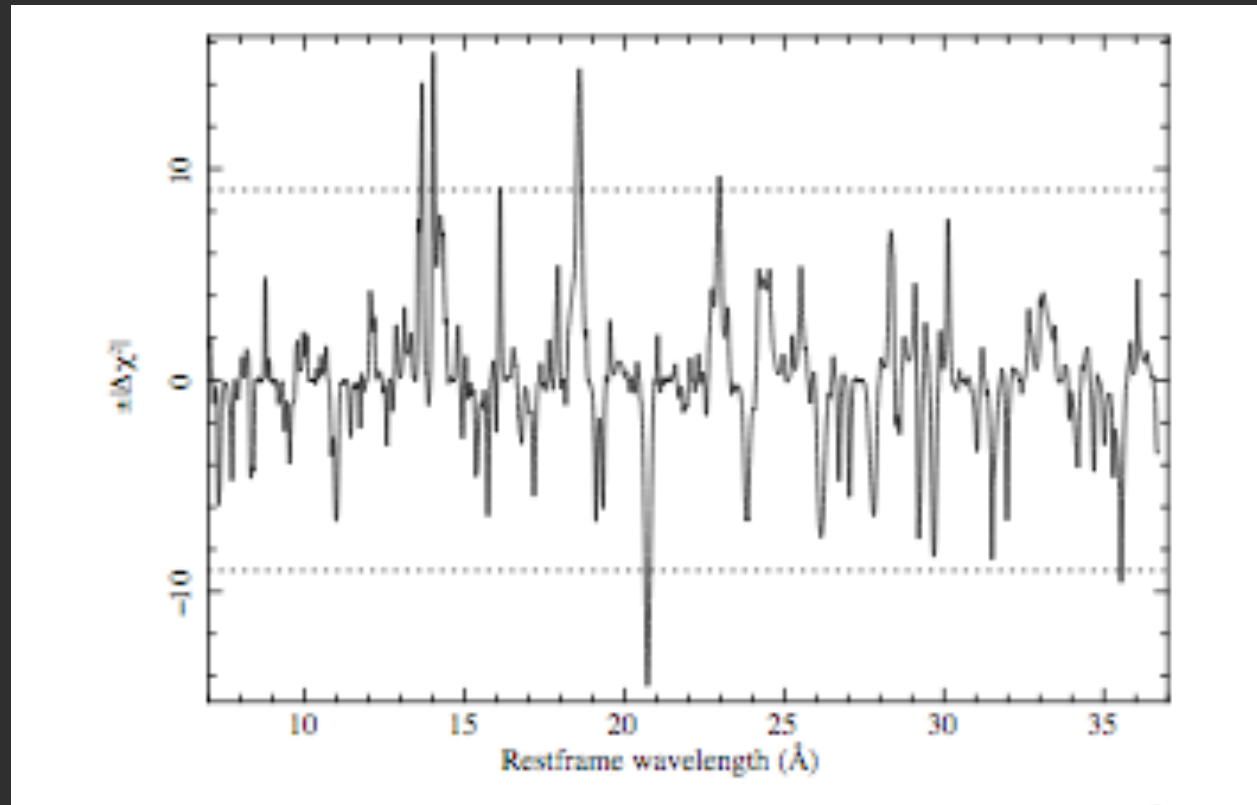


GALACTIC
SOURCES

34 EXTRAGALACTIC (RED)

28 GALACTIC (GREEN), DISTANCE=[0.3, 50] KPC

SOMETHING INTERESTING ...

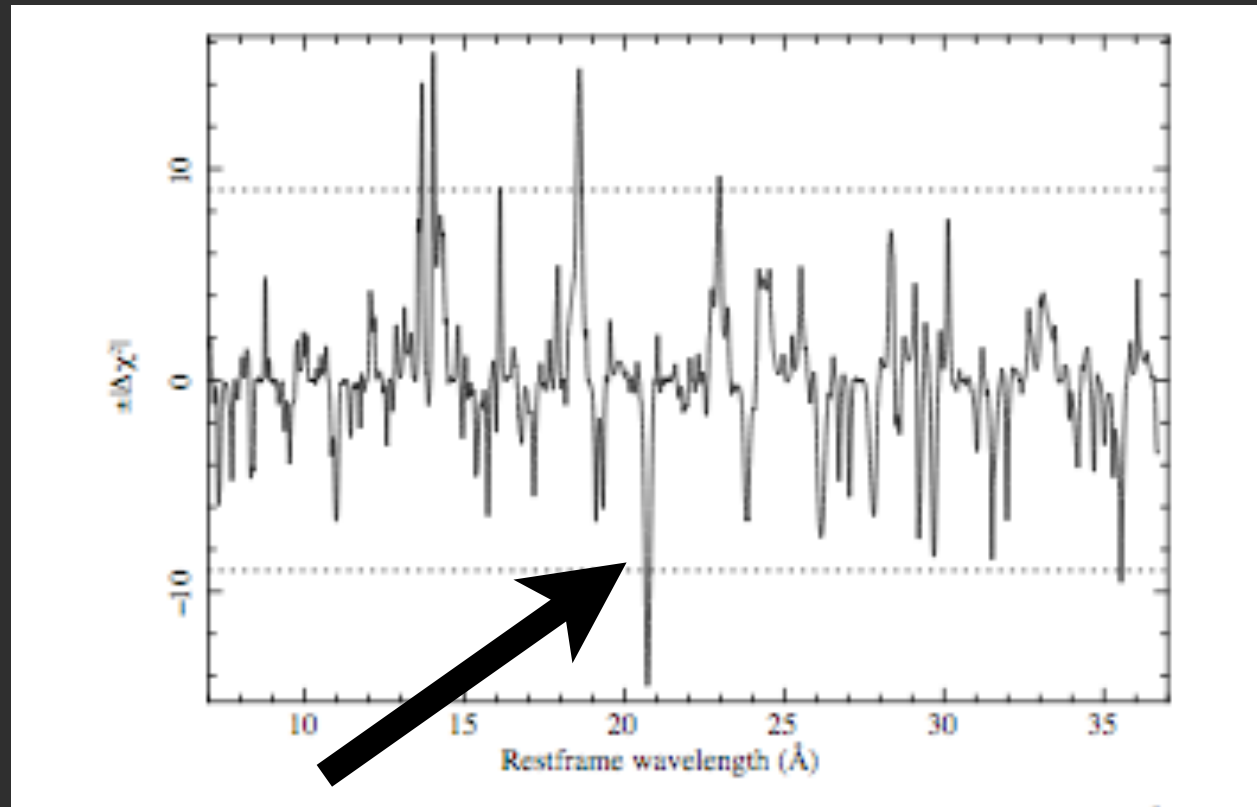


cannot find a consistent interpretation for them all. There is no plausible identification for the possible absorption line

at ~ 20.7 Å. In general, the soft X-ray spectrum contains no evidence of a warm absorber type outflow.

BY WHOSE-NAME-SHOULD-NOT-BE-MENTIONED, 2008

SOMETHING INTERESTING ...



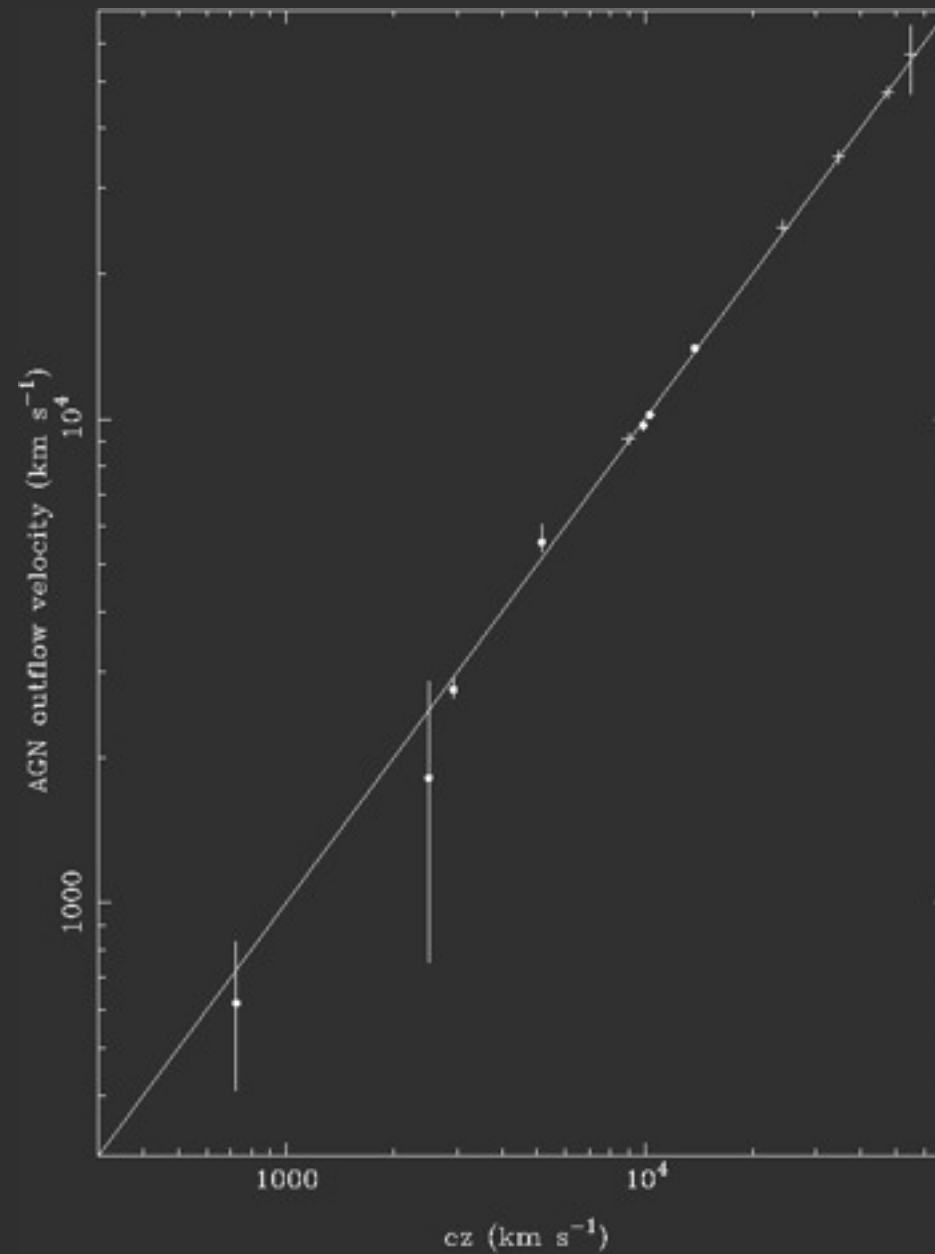
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at ~ 20.7 Å. In general, the soft X-ray spectrum contains no evidence of a warm absorber type outflow.

BY WHOSE-NAME-SHOULD-NOT-BE-MENTIONED, 2008

AND SOMETHING LIKE A “COSMIC CONSPIRACY”?

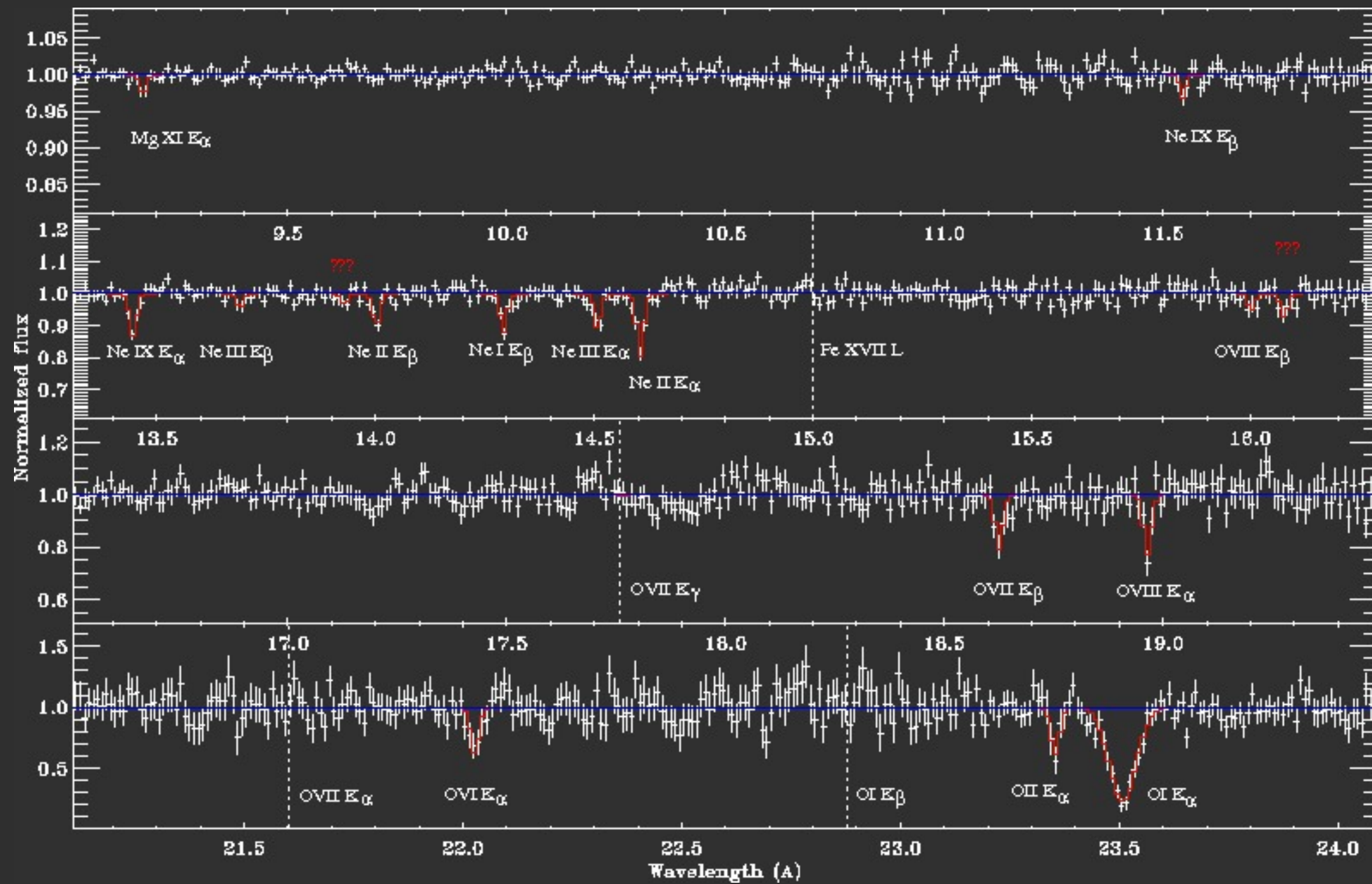
AGN
OUTFLOW
OR LOCAL
HOT GAS?



MCKERNAN ET AL. (2003)

AND SOMETHING WEIRD ...

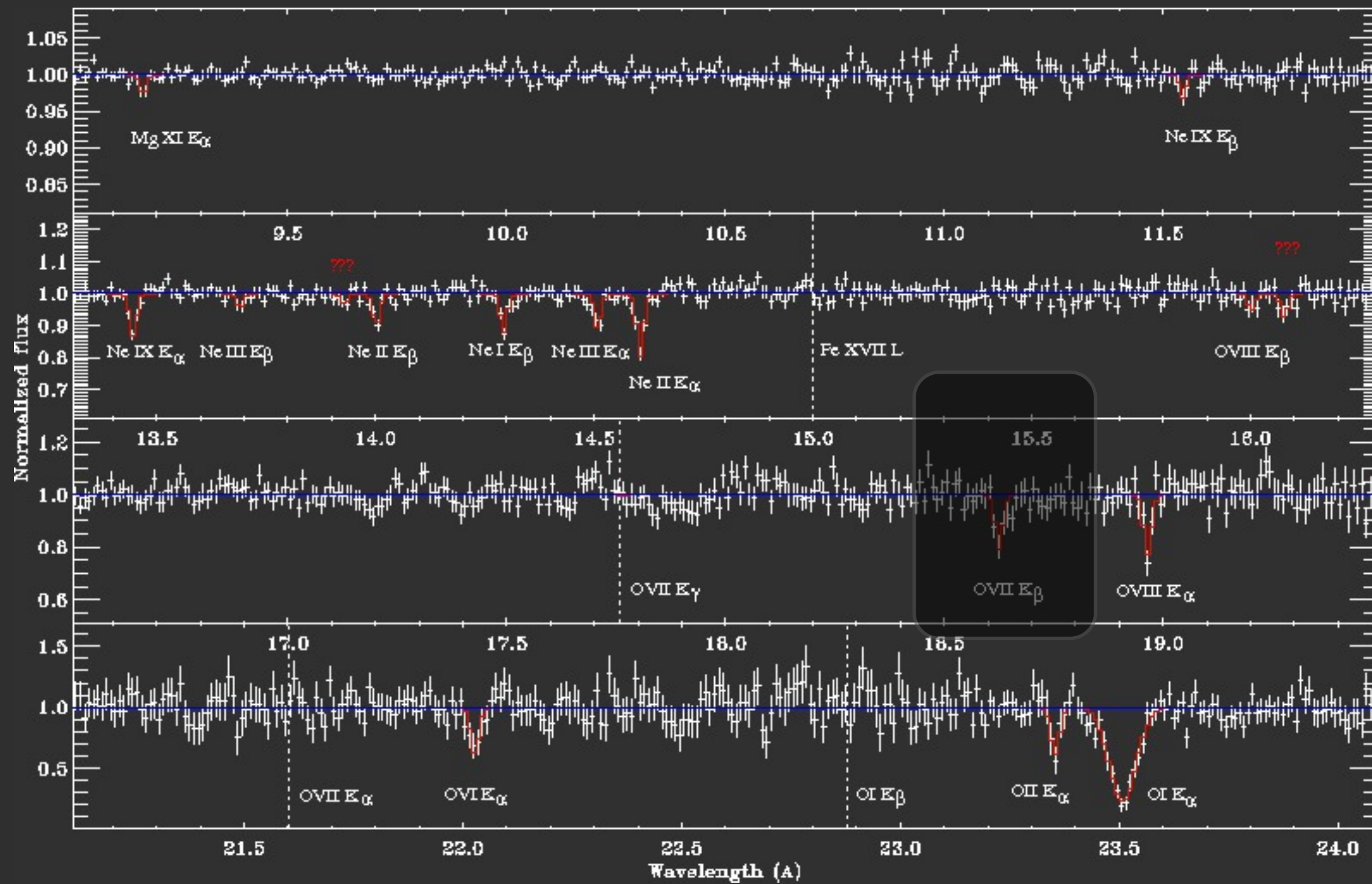
CYG X-2, CHANDRA



YAO ET AL. (2009)

AND SOMETHING WEIRD ...

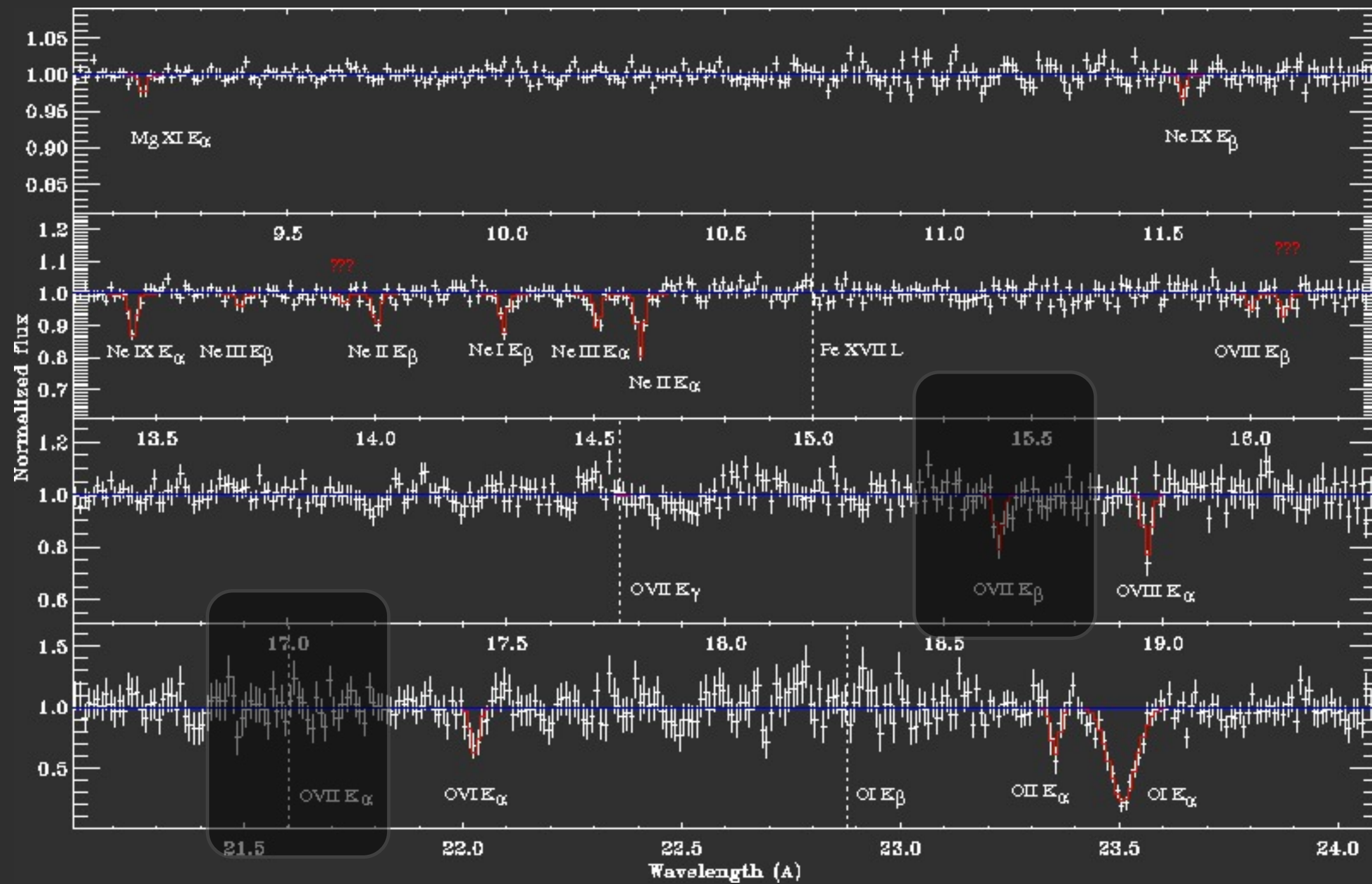
CYG X-2, CHANDRA



YAO ET AL. (2009)

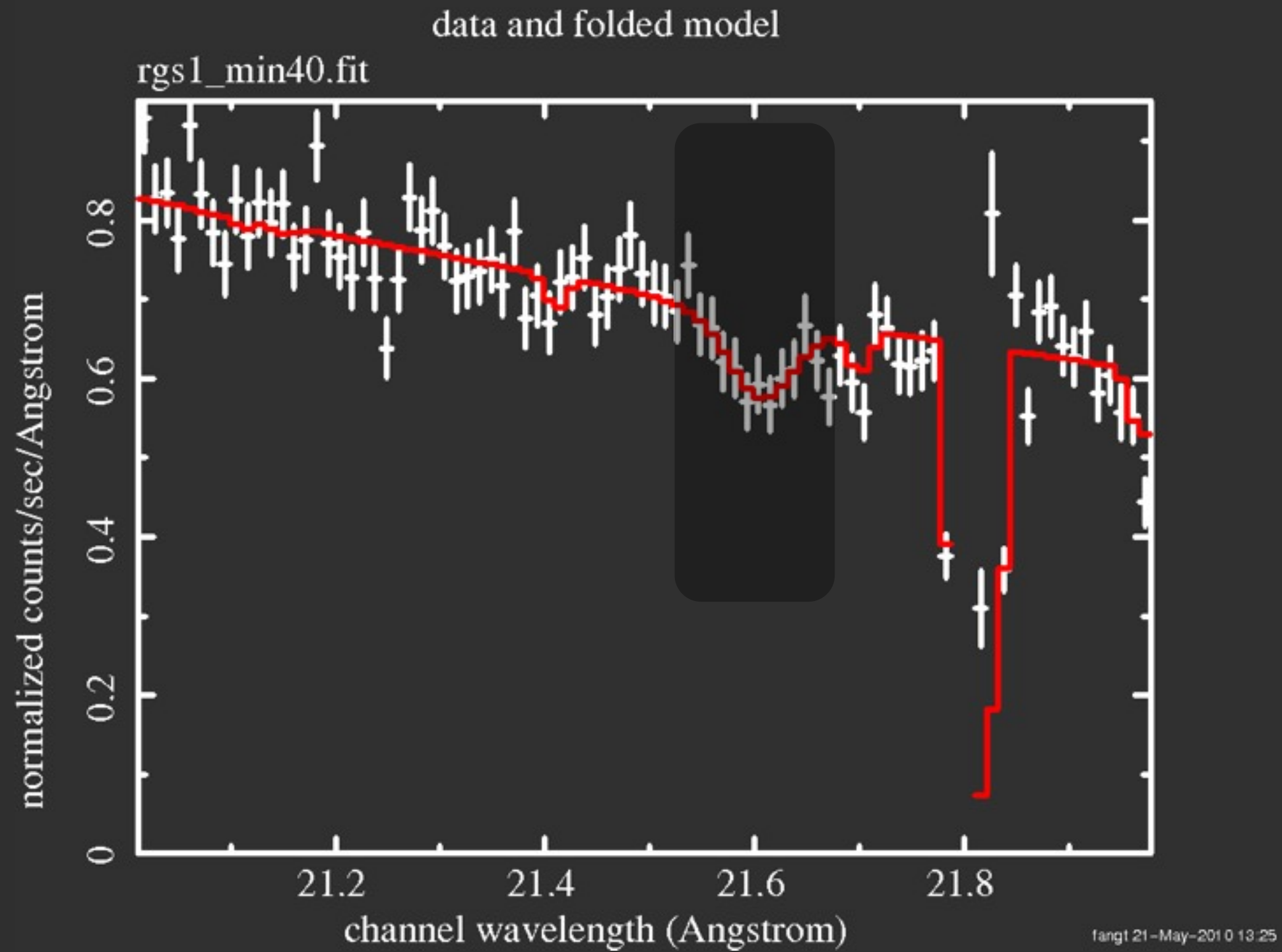
AND SOMETHING WEIRD ...

CYG X-2, CHANDRA



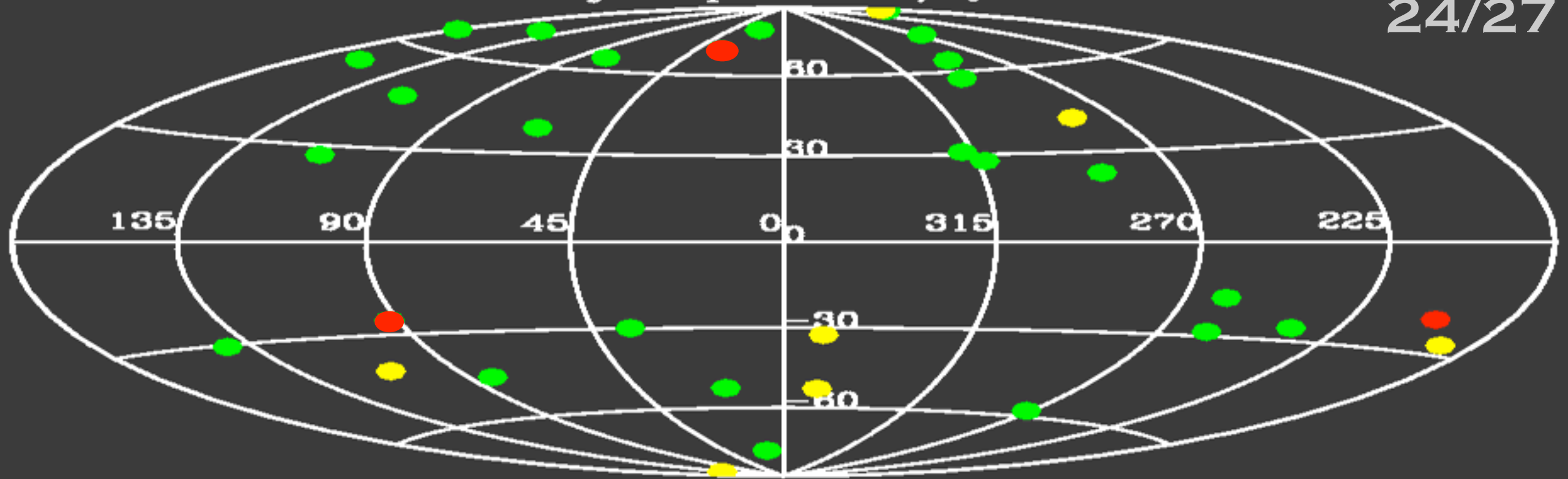
YAO ET AL. (2009)

CYG X-2, XMM RGS



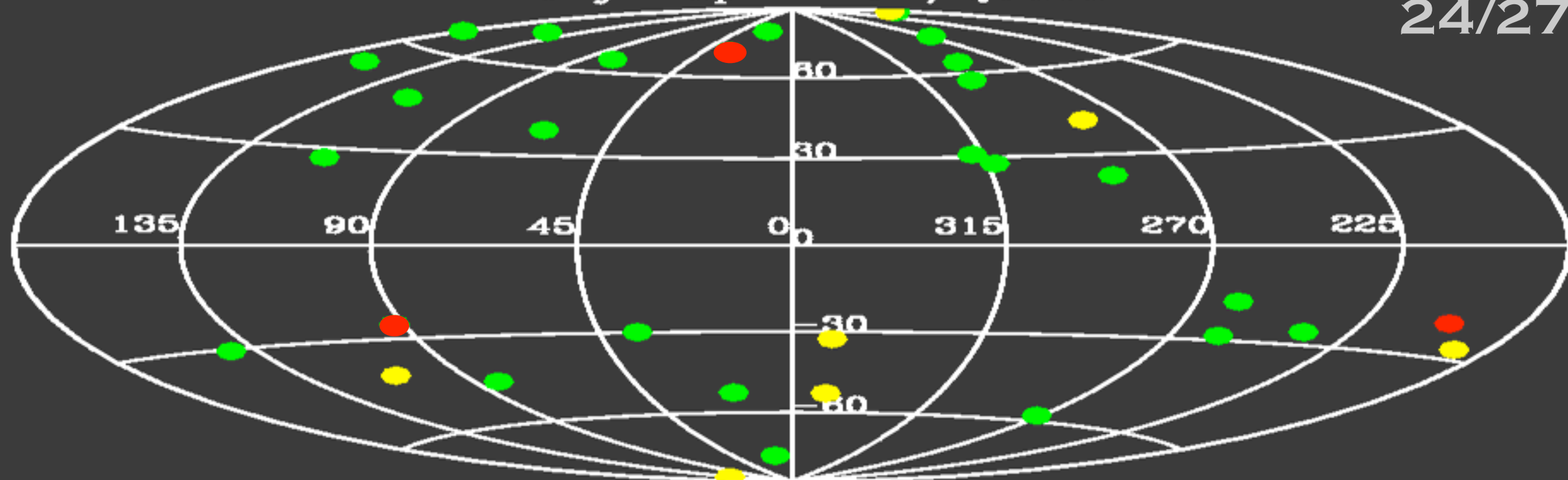
All Sky Map – AGN/Quasar

24/27



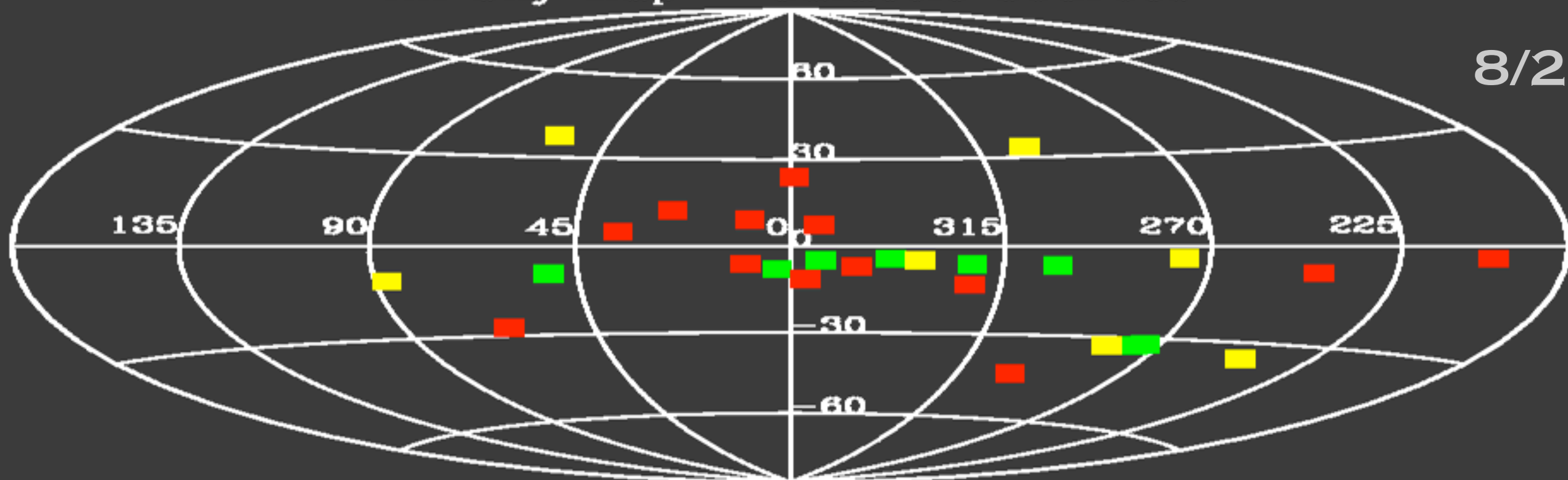
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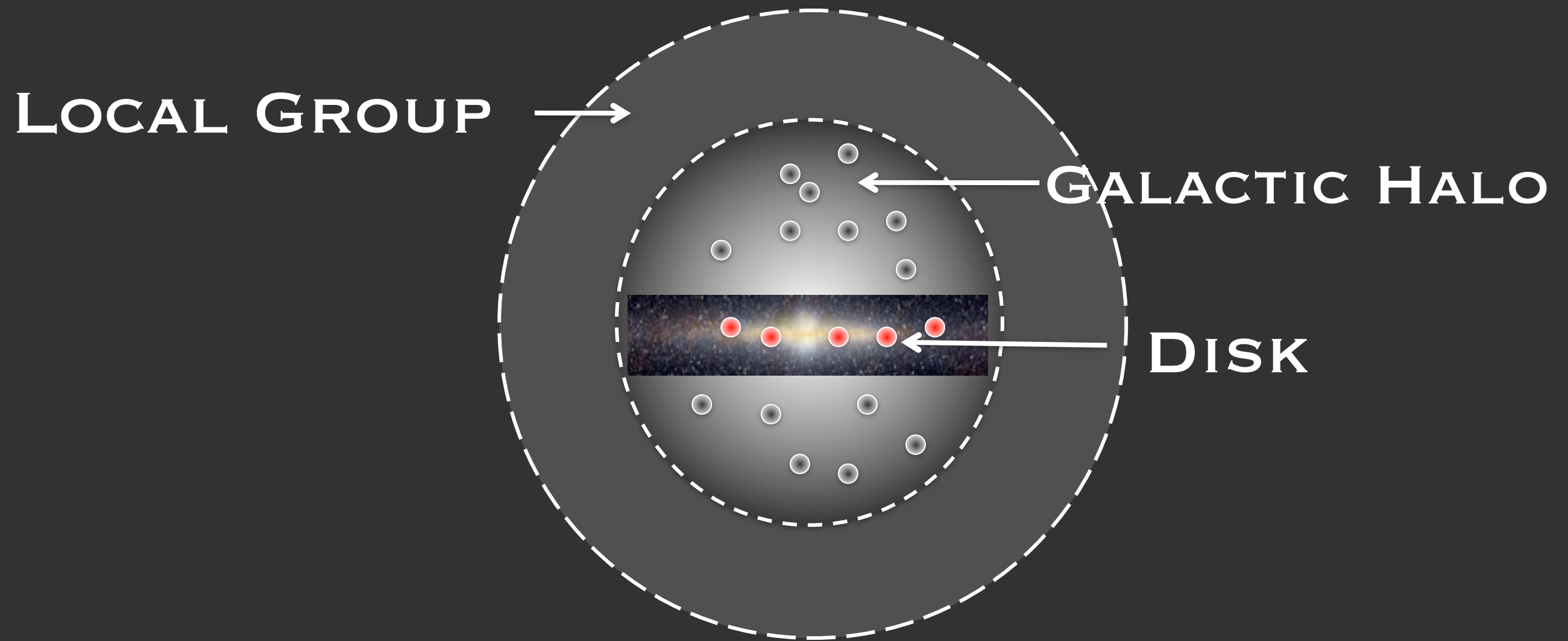
24/27



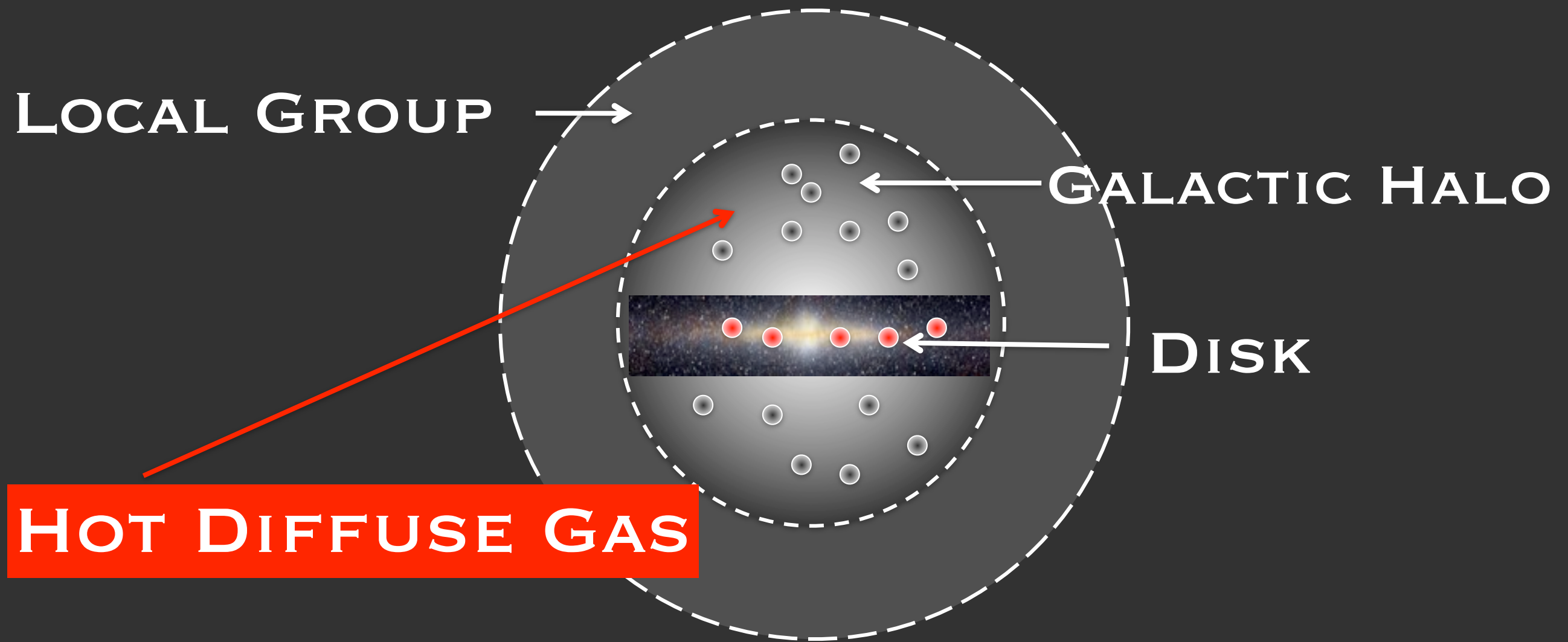
All Sky Map – Galactic Sources

8/23

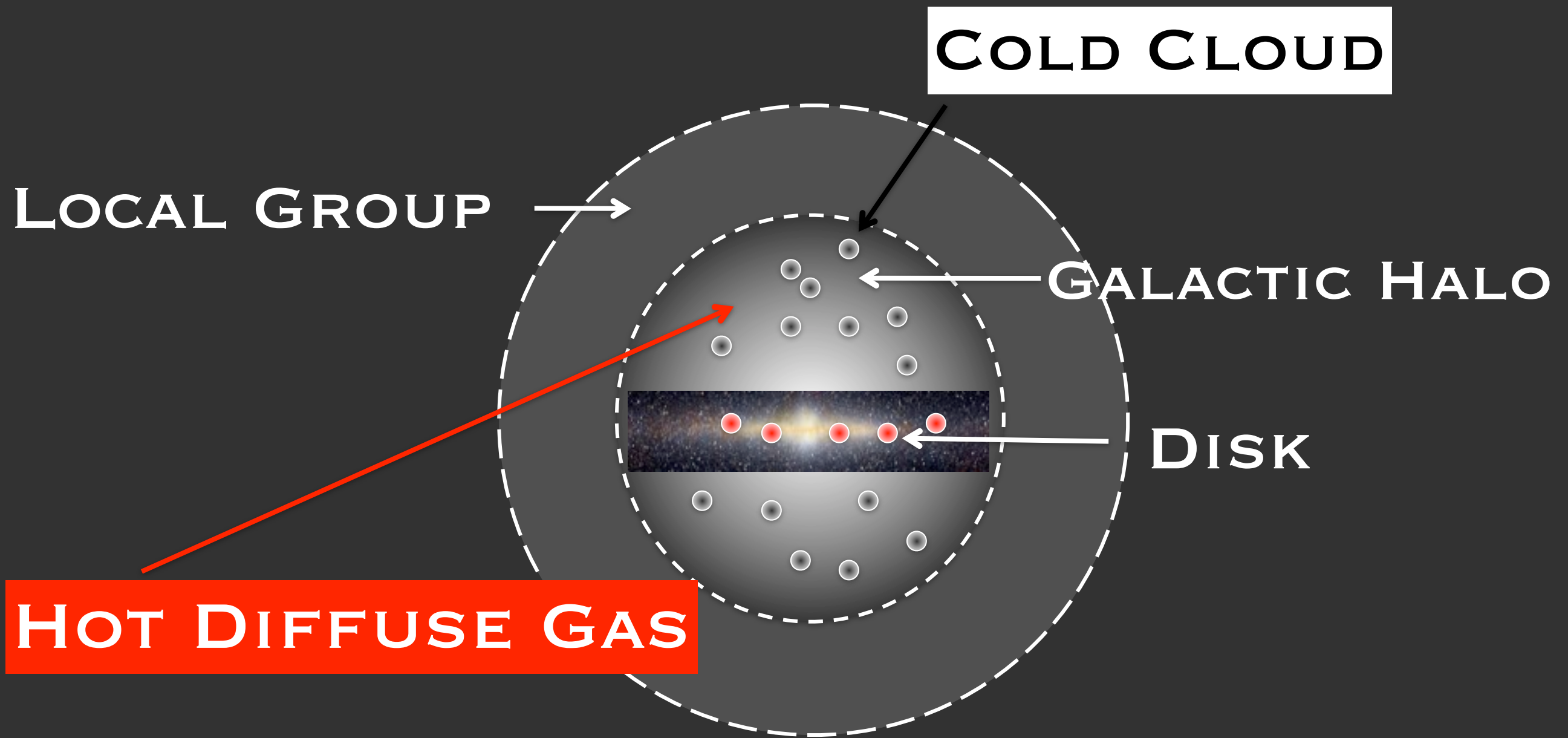




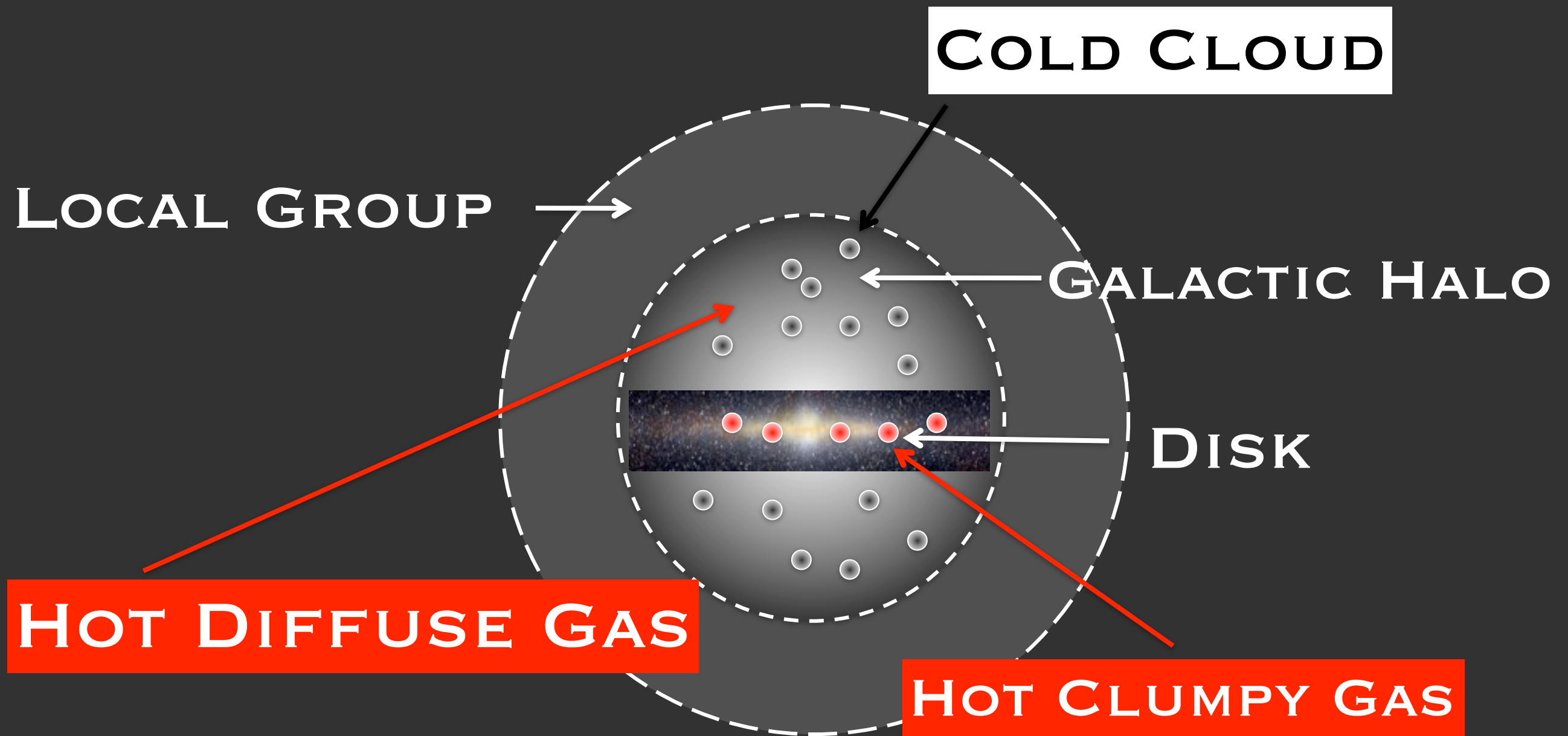
FANG ET AL. (2010)



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FANG ET AL. (2010)

SUMMARY

- Searching for the missing baryons in the known structures
- Missing baryons: large-scale IGM, or galactic halos?
- International X-ray Observatory!